GE
Measurement & Control

Moisture

Optica™

Operator's Manual

imagination at work

A40238752 Rev. E
April 2012

Optica™

General Eastern Dew Point Analyzer

Operator's Manual

A40238752 Rev. E
April 2012

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Chapter 1. Features and Capabilities

1.1 Introduction

The GE Measurement & Control *Optica* is a multi-purpose chilled-mirror hygrometer, suitable for use in a wide variety of applications. The *Optica* can function with any GE Measurement & Control chilled-mirror sensor to provide the following measurement ranges (depending on the sensor selected):

- dew/frost point from –80°C to +85°C (–112°F to +185°F)
- relative humidity from 0.002% to 100%
- moisture content from 500 ppb_v to over 5.71×10^5 ppm_v
- temperature from -100° to +100°C (-212°F to +212°F)

The *Optica* also measures and displays gas pressure using a GE Sensing PT-30A or PT-300A pressure sensor, or a user-supplied 4–20 mA or 0–5 VDC pressure sensor.

Note: *If the pressure is known to be constant, a fixed pressure can be programmed, eliminating the need for a pressure sensor.*

Using the *Optica*, you can simultaneously measure and display dew point, temperature and pressure, with a wide variety of units of measure. The *Optica* is Ethernet-ready, so you can access the unit using the Internet for remote monitoring applications. You can use the data logging function to record and upload weeks of data.

1.2 Electronics Enclosure

The *Optica* is available in two configurations:

- a benchtop model, with an optional rack-mount adapter available
- a wall-mount unit, housed in a NEMA-4 enclosure, suitable for industrial environments

See Chapter 2, *Installation*, for details on how to mount the *Optica*.

1.2.1 Front Panel

The Optica's front panel is shown in Figure 1 below. The panel includes: a display, an alphanumeric keypad for data entry, ENTER and TAB keys, and four softkeys to the right of the display screen.

Two display options are available:

- a high-resolution full-color liquid crystal display (LCD) with data graphing and on-screen programming capability (referred to as the "VGA" unit). See Figure 1 below.
- a 4-line by 40-character alphanumeric display (referred to as the "4x40" unit).

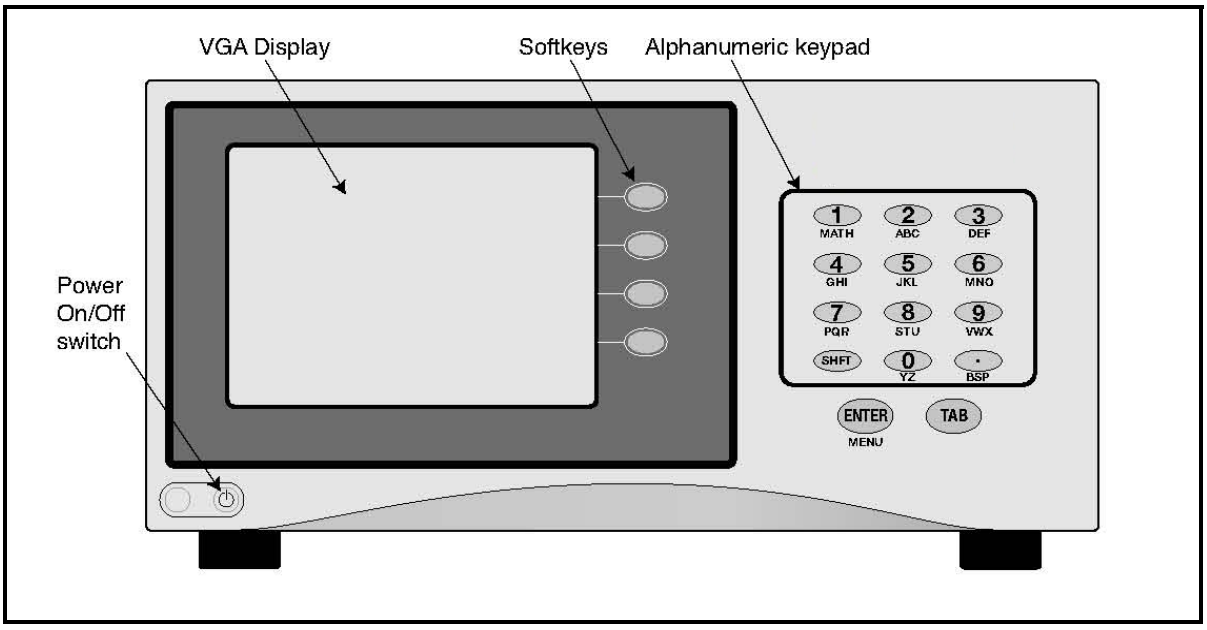

Figure 1: *Optica* Benchtop Version with VGA Display

1.2.2 Input/Output Capability

Available inputs and outputs include the following:

- 4-wire Resistance Temperature Detector (RTD) input
- 4–20 mA and 0–5 VDC Pressure Sensor inputs
- two simultaneous analog outputs, each with 4–20 mA and 0–5 VDC capability
- two independent alarm relays (Form C, 5 Amp)
- serial communications port
- Ethernet 10BaseT (on VGA Optica only)

The *Optica* uses the GE Measurement & Control patented Programmable Automatic Contaminant Error Reduction (PACER) system for automated self-cleaning and optics rebalancing.

Detailed specifications for the *Optica* are given in Appendix A.

1.3 The System

1.3.1 System Components

A complete *Optica* system consists of the following items:

- Electronic monitor
- Dew point sensor
- Interconnecting sensor cable
- AC line cord
- Certification that the unit is traceable to the National Institute of Standards and Technology (Certificate of Conformance)
- Temperature sensor (optional)
- Pressure sensor (optional)
- Maintenance kit
- User's Manual

1.3.2 System Planning

The *Optica* can be used for a wide variety of measurement applications, including the measurement of dew points of gasses that are at pressures that exceed the measurement range of GE's sensors. In this situation be sure to check the section *Process Pressure* on page 32 for installation planning.

1.4 Sensors

The *Optica* can be configured with a chilled-mirror dew point sensor. The specific sensor is chosen according to the expected dew point range and the environment in which the dew point is to be determined. In addition, the *Optica* can be configured with a temperature and/or pressure sensor. GE provides the following sensors for various applications:

1.4.1 Dew Point Sensors

- Model 1111H — Single-stage sensor
- Model 1211H — Two-stage sensor; high pressure and temperature
- Model D-2 — Two-stage sensor
- Model SIM-12H — Two-stage heated sensor
- Model 1311DR — Four-stage, liquid or air cooled sensor
- Model 1311XR — Five-stage, liquid cooled sensor

1.4.2 Temperature Sensor

- Model T-100E

1.4.3 Pressure Sensor

- Model PT-30A or PT-300A

1.5 Theory of Operation

Optical condensation hygrometry is a precise technique for determining the water vapor content in gases by directly measuring dew point or frost temperatures. Using this technique, a metal mirror is cooled until it reaches a temperature at which a thin layer of condensation begins to form on it. The dew layer is detected optically, and the mirror is held at that temperature. The mirror temperature, measured with a platinum resistance thermometer, is an accurate indicator of the dew or frost point. Because these hygrometers are so accurate, they are widely used as a standard in many of the world's metrology laboratories.

1.5.1 Hygrometer Function

Figure 2 on page 5 illustrates how GE Measurement & Control hygrometers detect and measure dew point. The condensate mirror is illuminated with a solid state, infrared emitter (IR). A photodetector monitors the IR light reflected from the mirror. The photodetector is fully illuminated when the mirror is clear of dew, and it receives less light as dew forms. A separate LED and photodetector pair are used as a known reference to compensate for any thermally induced changes in the optical components. The photodetectors are arranged in an electrical bridge circuit, the output current of which is proportional to the light reflected from the mirror. The bridge output controls the electrical current to the thermoelectric cooler.

A large bridge current develops when the mirror is dry, causing the mirror to cool toward the dew point. As dew begins to form on the mirror, less light is reflected, and the bridge output decreases. This, in turn, causes a decrease in cooling current. A rate feedback loop within the amplifier ensures critical response, causing the mirror to stabilize quickly at a temperature that maintains a thin dew or frost layer on the mirror surface. A precision thermometer element embedded within the mirror directly monitors this dew point temperature.

1.5.2 Hygrometer Calibration

The *Optica* unit can be sent to the National Institute of Standards and Technology (NIST) in Gaithersburg, Maryland for certification or to any National Standards lab for calibration against their primary humidity standards. A calibrated instrument can then be used as a transfer standard in local laboratories to calibrate lower echelon instruments.

CAUTION! Field calibration is not recommended.

Hygrometers used as calibration standards must have the following characteristics:

- The mirror thermometer must have suitable long-term accuracy (such as that obtained with a platinum resistance thermometer).

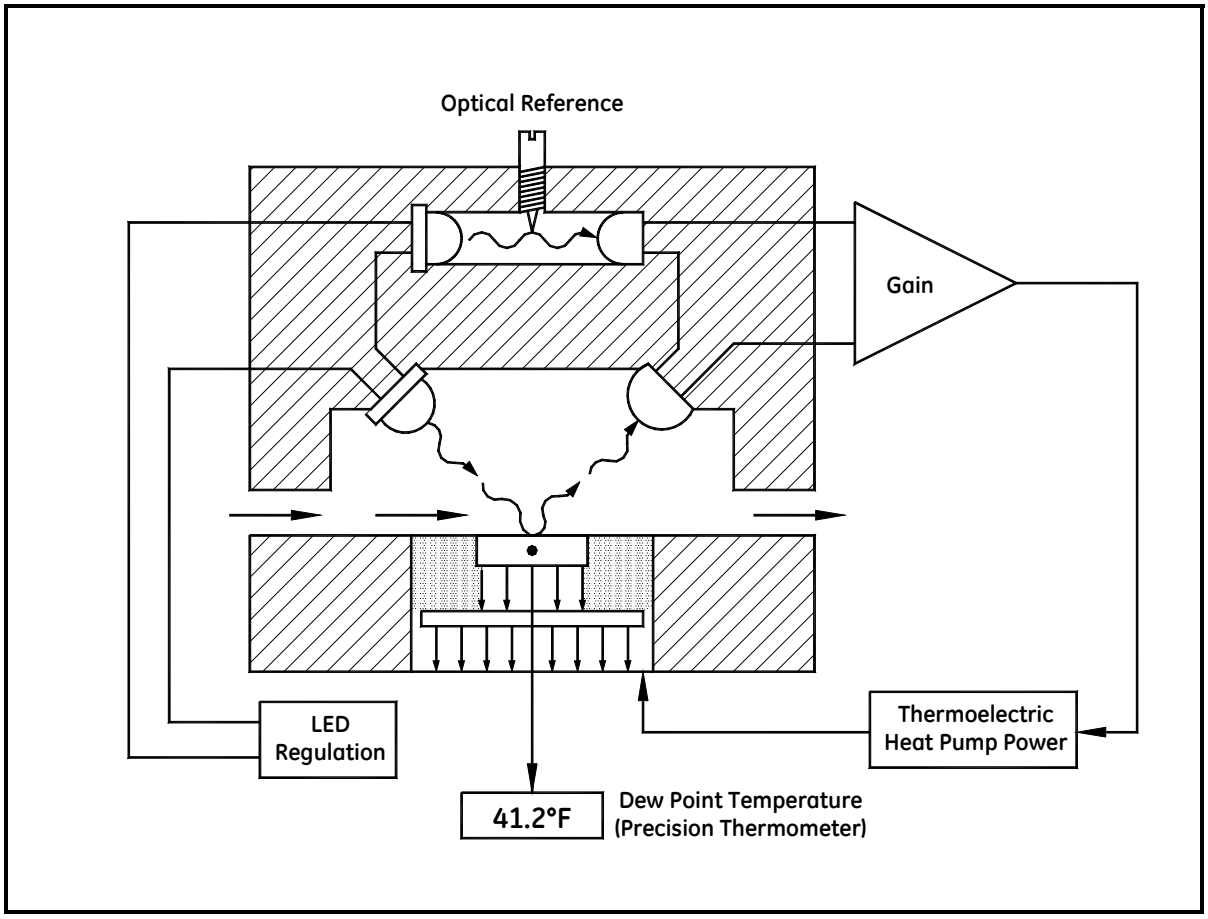

Figure 2: Chilled-Mirror Hygrometer Diagram

1.5.3 Other Hygrometer Applications

Many GE Measurement & Control Chilled Mirror Hygrometers are used in industrial applications in addition to metrology. The optical condensation hygrometer is not readily damaged or contaminated by industrial process gases that can degrade other secondary measurement schemes such as saturated salt and polymer-based sensors. If the sensor or sampling components should become contaminated with oils, salts, etc., they can be cleaned without harm to the sensor or impairment to the system accuracy. The performance of the hygrometer can be checked at any time by heating the mirror above the dew point, causing the dew deposit to evaporate, then reclosing the servoloop and checking to see that the system cools and returns to the same dew point.

The GE optical condensation sensors cover a wide range of applications limited only by the heat pumping capabilities of the thermoelectrically-cooled mirror.

At high dew points (up to 100°C), the sensor is limited by the thermal properties of the solid state optical components as well as the thermoelectric heat pump capacity.

In a typical application measuring sub-ambient dew points, a two-stage thermoelectrically-cooled mirror can reach a temperature approximately 65°C lower than an ambient (heat sink) temperature of +25°C. The thermoelectric cooler pumps heat from the mirror into the heat sink. By reducing the temperature of the heat sink with a coolant such as chilled water, or by applying the sensor in a low-temperature condition such as monitoring of a test chamber, even lower dew points can be measured. In meteorological applications where the heat sink temperature is considerably lower, frost points down to –75°C can be monitored.

Four- and five-stage sensors are available for measuring the lowest dew/frost points.

1.6 The PACER Cycle

GE Measurement & Control has developed and patented a compensation technique called PACER (Programmable Automatic Contaminant Error Reduction) that is very effective in reducing the Raoult Effect error associated with soluble contaminants, particularly for near-ambient dew points. The Optica is equipped with the PACER cycle as well as AUTO balance as found on earlier models. The user can choose which self-cleaning and balancing routine to run depending on the severity of contamination.

The PACER cycle, diagrammed in Figure 3 below, begins with a coalescence period, during which the mirror is cooled well below the dew point of the sample gas, condensing out a large amount of water.

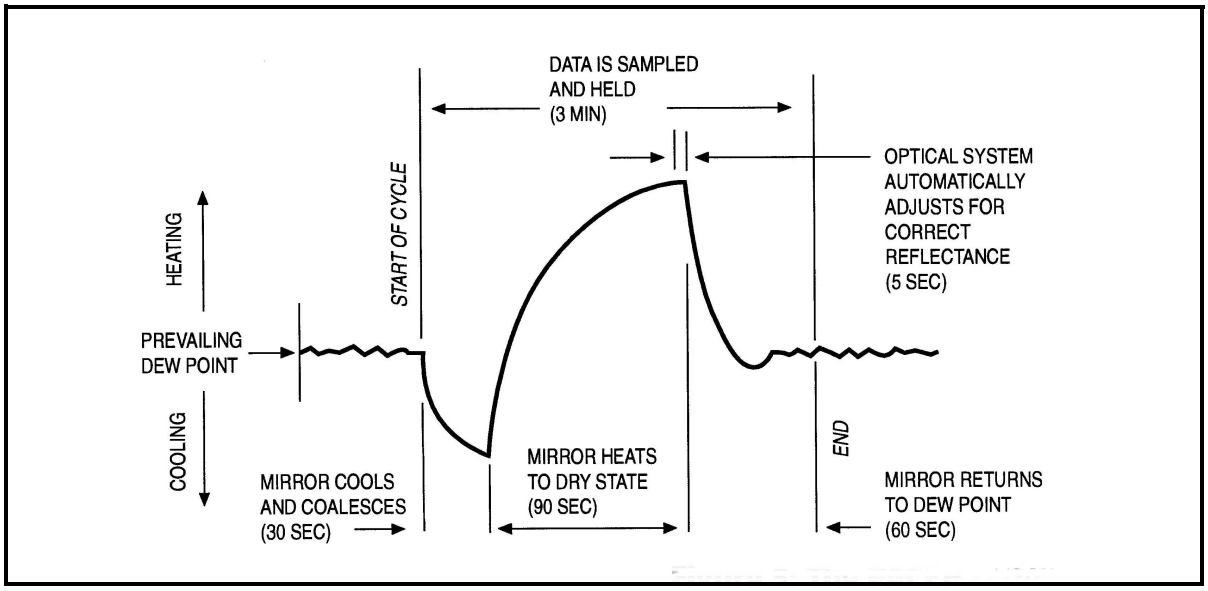

Figure 3: A Typical PACER Cycle

This excess water easily dissolves any water-soluble contaminants. The mirror is then heated. During the heating phase, the large puddles of water gradually evaporate, carrying increasingly heavy concentrations of salts as the puddles become smaller. Finally, when all the puddles have evaporated, dry "islands" of crystallized salt are left on the mirror. The area between the islands (80-85% of the mirror surface) is now clean and shiny, whereas before the PACER cycle it may have been completely covered. The total amount of contamination has not been reduced, but instead, redistributed as shown in Figure 4 below, with more clean mirror surface available for dew formation. The reflected light signal is then electronically balanced against the reference.

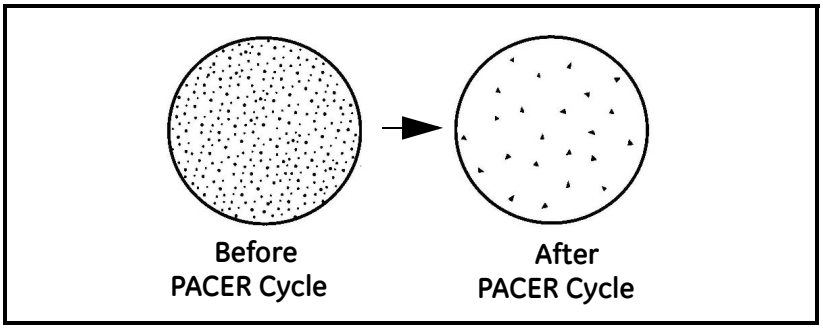

Figure 4: Results of the PACER Cycle

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Chapter 2. Installation

2.1 Introduction

This chapter explains the installation of the benchtop and wall-mount versions of the *Optica*, the various sensors used with the system, and the I/O and power wiring.

2.2 Benchtop Installation

2.2.1 Mounting the Benchtop

The *Optica* benchtop dimensions are shown in Figure 5 below. Two feet on the bottom of the case can be unfolded to raise up the front for easier viewing, if desired.

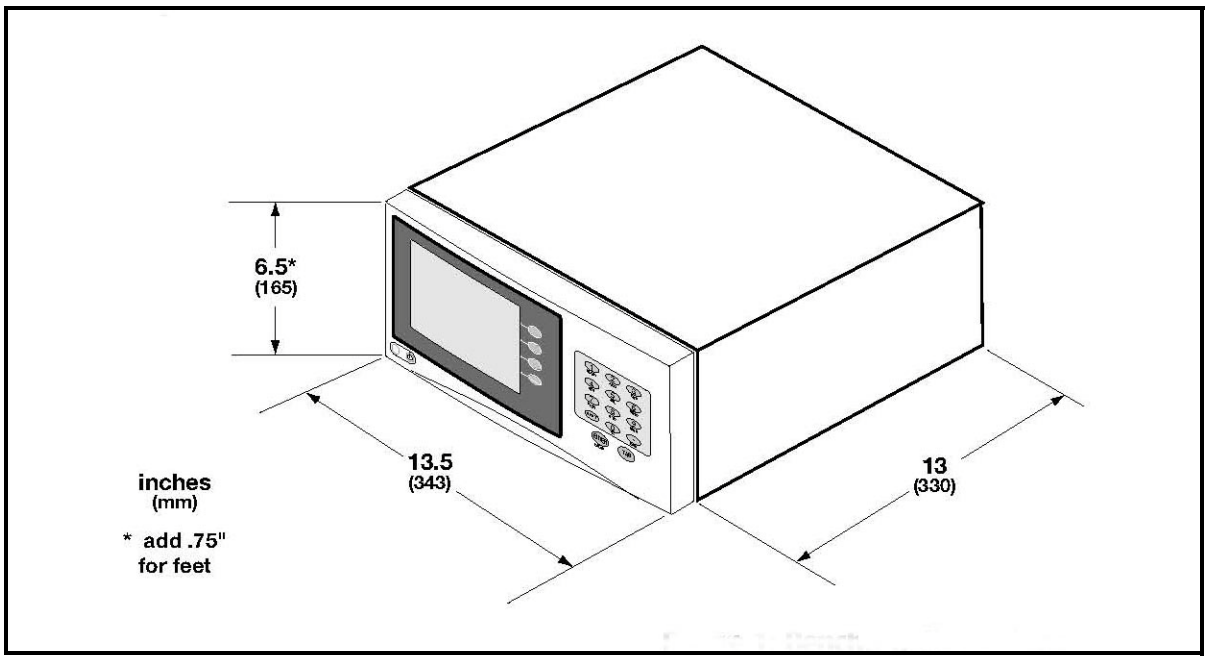


Figure 5: *Optica* Benchtop Dimensions

2.2.2 Using the Rack Mounting Option

There is an optional kit for mounting the benchtop unit in a standard 19-inch rack (see Figure 6 below, Figure 7 on page 11, and Figure 8 on page 12). The two brackets are attached to the front panel using four No. 8 screws. The *Optica* is mounted to the brackets using the eight mounting holes located just in front of and behind the unit's feet.

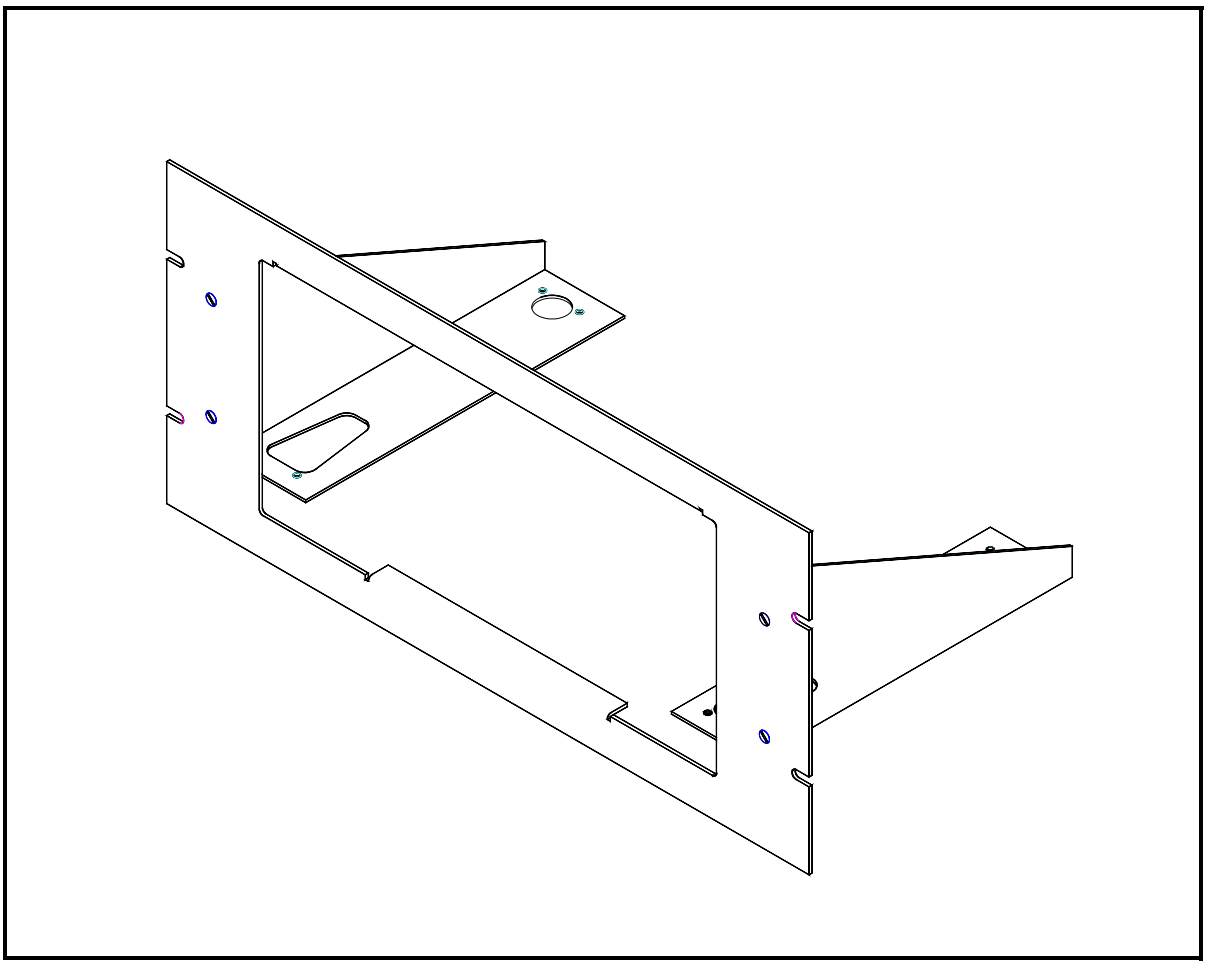


Figure 6: *Optica* Rack-Mount Adapter

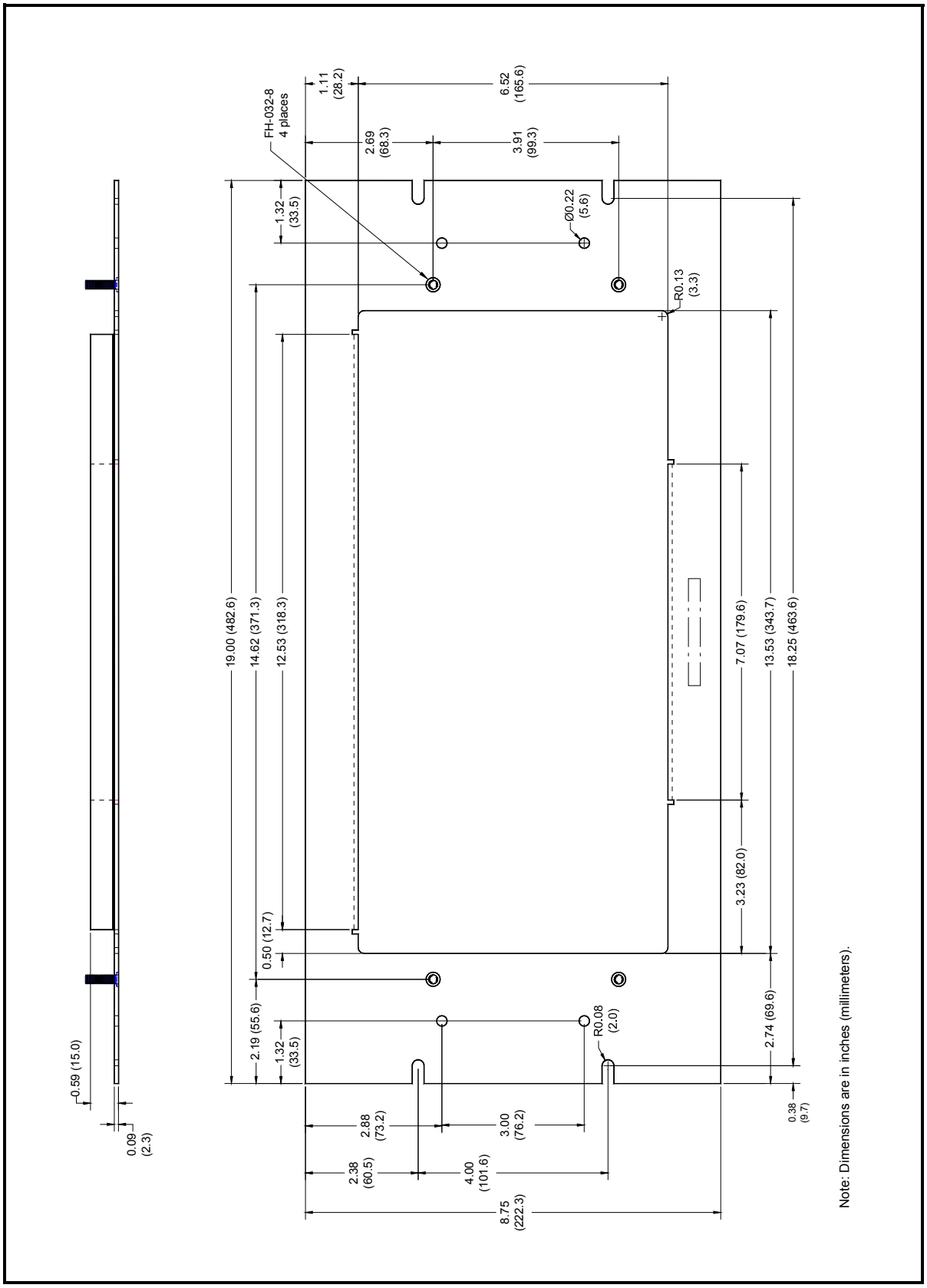


Figure 7: *Optica* Rack-Mount Adapter - Front Panel

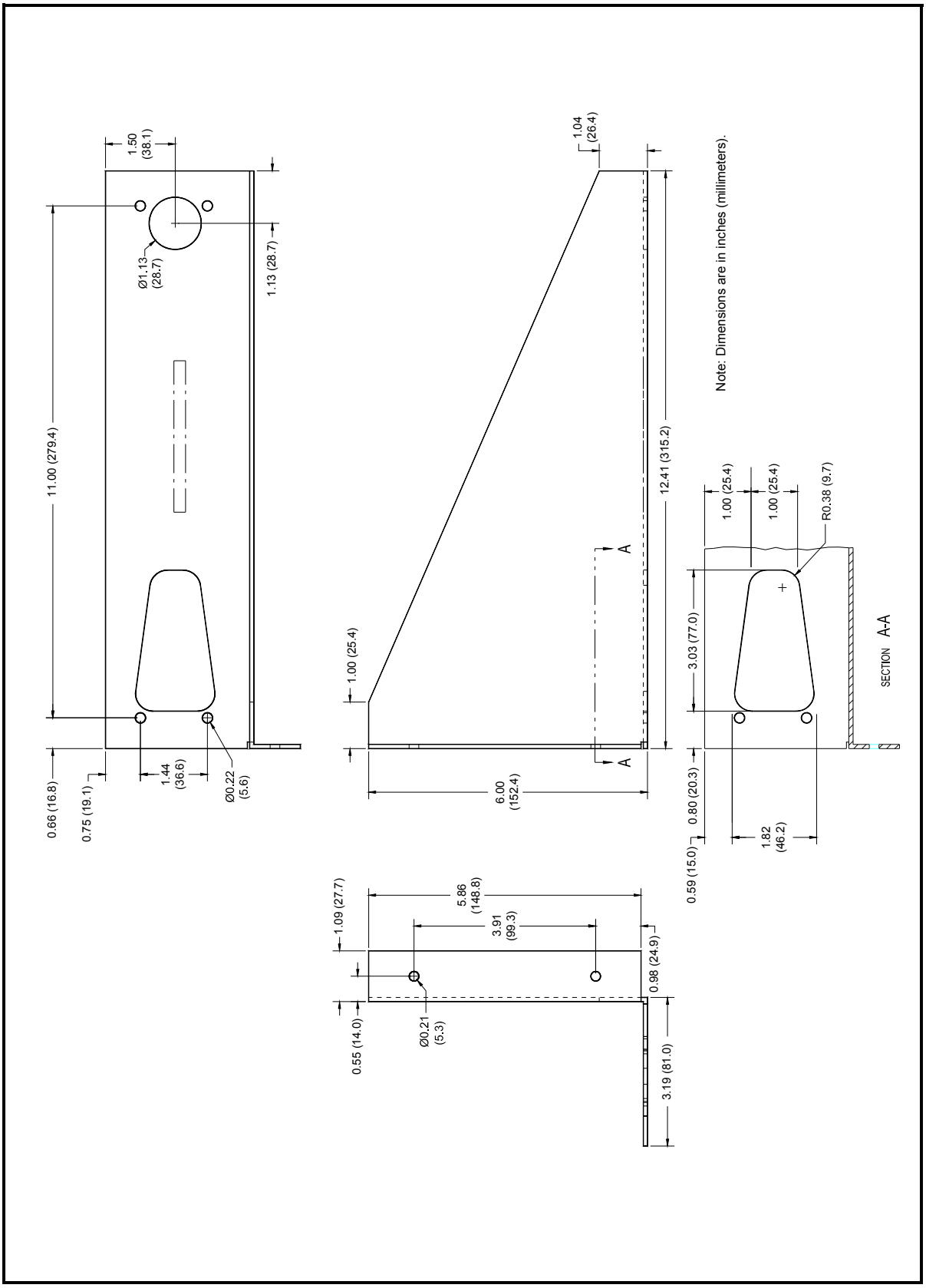


Figure 8: *Optica* Rack-Mount Adapter - Bracket

2.2.3 Wiring the Benchtop

2.2.3a Input Power

The *Optica* operates with input power from 90 to 126 VAC at 4 amps, or from 208 to 252 VAC at 2.5 amps. It is designed for a nominal 100, 115 or 230 VAC source. A switch on the rear panel selects the appropriate voltage range (see Figure 9 below):

- The 115 VAC setting operates over a range of 90 to 126 VAC
- The 230 VAC setting operates over a range of 200 to 253 VAC

The Optica's voltage and frequency rating are listed on the rear panel.

2.2.3b Sensors

Connect the dew point sensor cable to the 25-pin connector in Slot B on the *Optica*'s rear panel (see Figure 9 below). Connect the optional temperature sensor cable to the 9-pin connector in Slot B on the rear panel. The optional pressure sensor and other I/O wiring connects to the terminal block in Slot A.

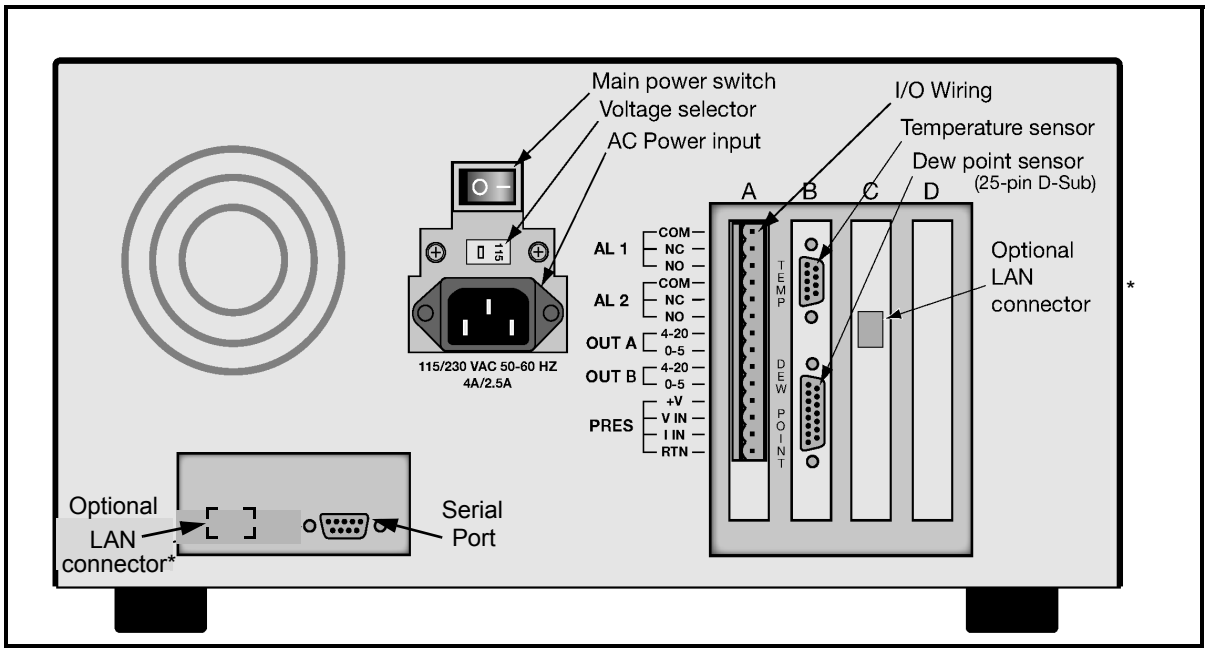


Figure 9: *Optica* Benchtop Rear Panel

Note: **Depending on the model revision, the LAN connector is located in one of two places.*

2.3 Wall-Mount Installation

The *Optica* Wall-Mount unit is designed to mount on a flat, vertical surface, such as a wall or panel. To mount the wall-mount version, see Figure 10 and Figure 11 below.

2.3.1 Mounting the Wall-Mount

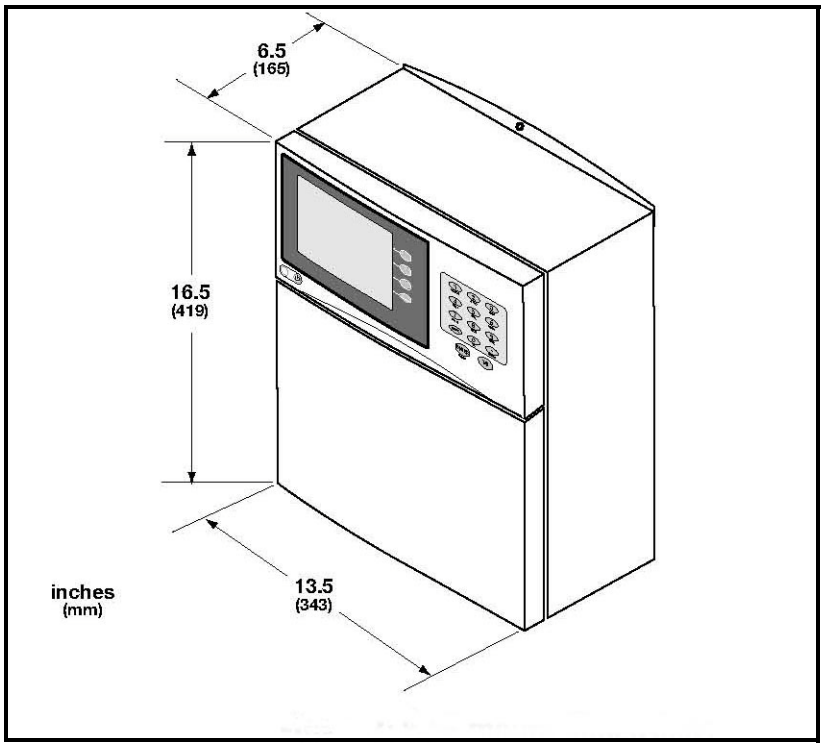


Figure 10: *Optica* Wall-Mount Dimensions

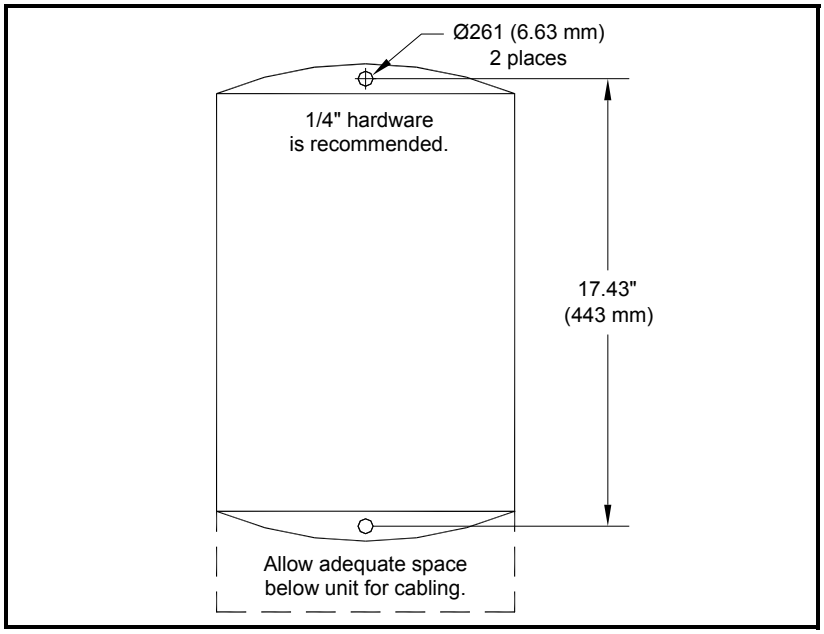


Figure 11: *Optica* Wall-Mount - Mounting Hole Locations

2.3.2 Wiring the Wall-Mount

All connections to the wall-mount unit are made through the panel at the bottom of the case as shown in Figure 12 below. Any I/O cabling is brought into the unit through a gland at the lower left of the case and connects to the terminal blocks on the left side of the case. Wiring for these connections is shown in Figure 15 on page 16. The dew point sensor and temperature sensor cable connectors are located near the center of this panel.

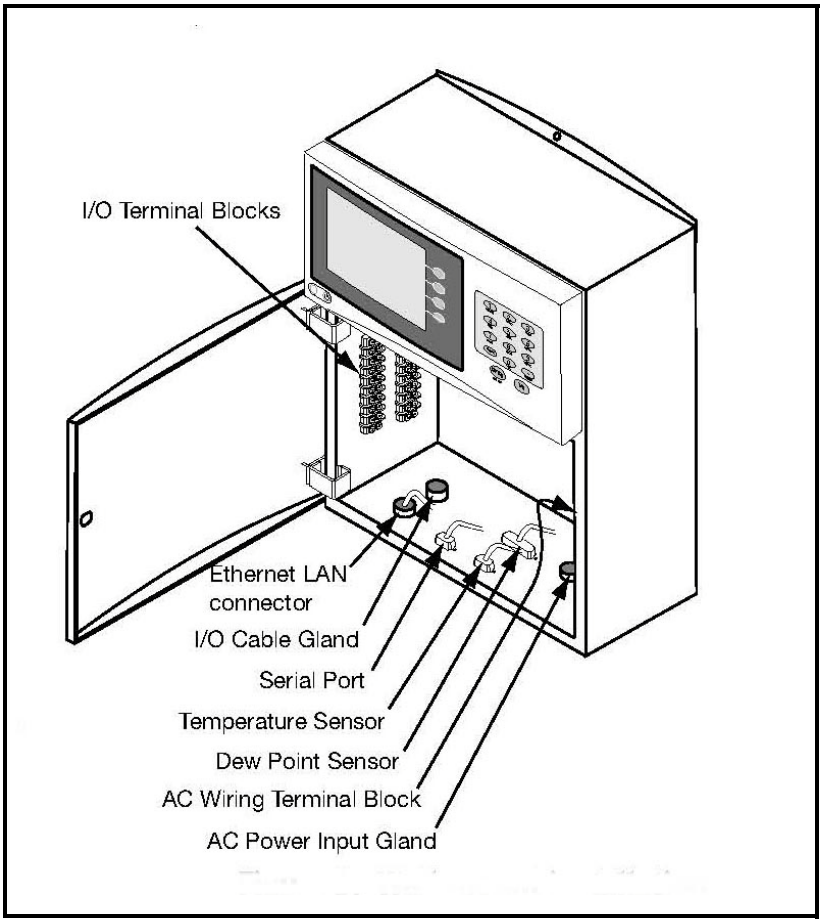


Figure 12: Wall-Mount Wiring Entrance Locations

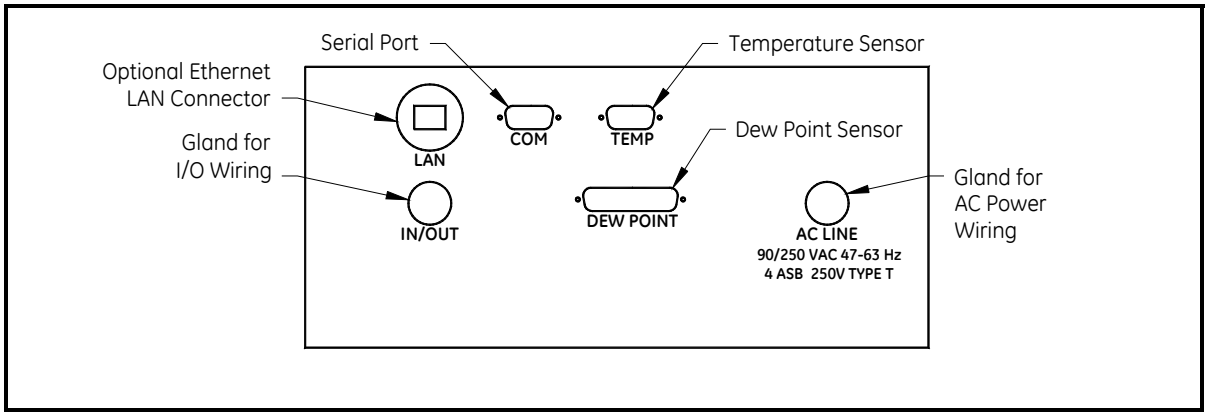


Figure 13: Wall-Mount Bottom Panel (viewed from under the unit)

2.3.2a Input Power

Power wiring enters the case through a gland fitting at the lower right of the unit and connects to a screw terminal block mounted on the right side of the case. Wiring of this terminal block is shown in Figure 14 below. The voltage and frequency rating and tolerances, as well as fusing data, are listed on the bottom of the unit.

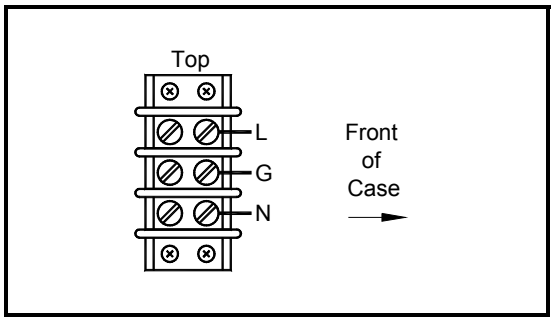


Figure 14: Wall-Mount AC Power Wiring

2.4 Output Wiring

The benchtop outputs are connected to removable terminal blocks on the rear panel. Figure 9 on page 13 shows the location of the benchtop terminal blocks and Figure 15 below shows the Slot A connections.

The Wall-Mount *Optica* input/output terminal blocks are located inside the front door as shown in Figure 12 on page 15. Cabling is brought in through the gland on the bottom of the unit and wired to the terminal blocks shown in Figure 15 below.

Note: *Output programming is described in Chapters 4, 5 and 6.*

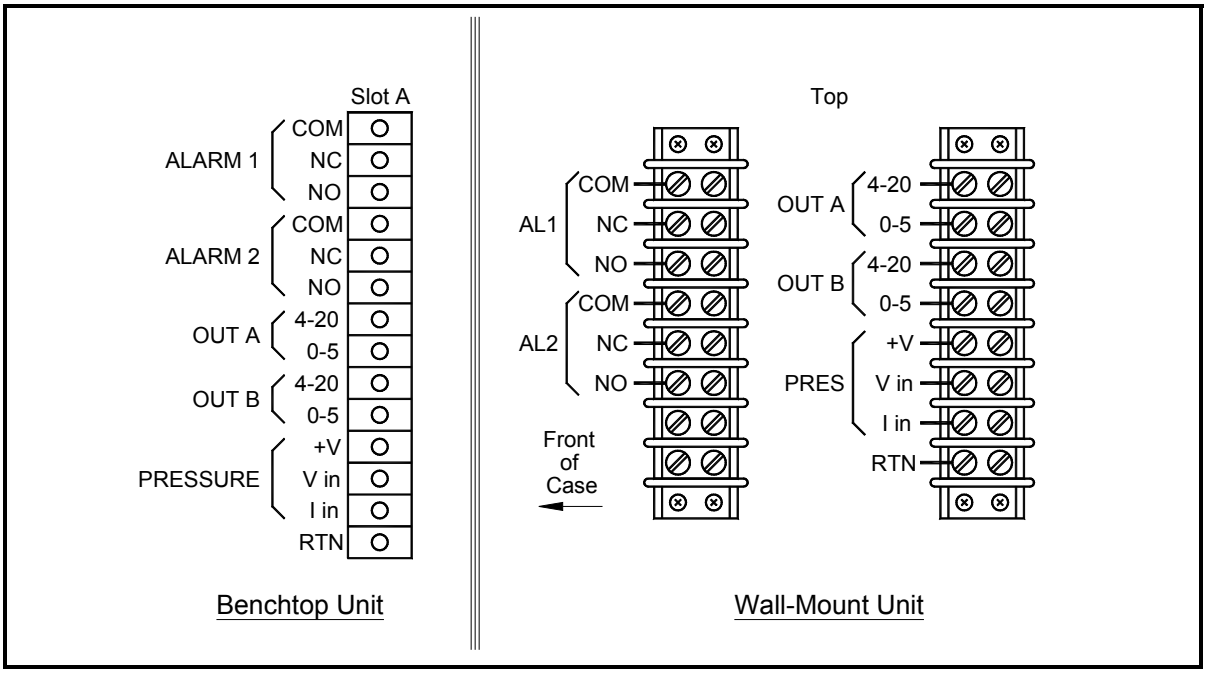


Figure 15: Benchtop and Wall-Mount Input/Output Terminal Blocks

2.4.1 Analog Outputs

Note: *When the Optica is being programmed, the analog outputs provide 4–20 mA and 0–5 VDC signals representing the designated parameters.*

- For 4–20mA output, connect to terminals labelled **4–20 (+)** and **RTN (–)**.

Note: *The maximum load allowed for current output is 500 Ohms.*

- For 0–5 VDC output, connect to terminals labelled **0–5 (+)** and **RTN (–)**.

Note: *The maximum load allowed for voltage output is 5 mA.*

Example:

Assume a temperature output, scaled to range from 0°C (Tlower) to 100°C (Tupper), with a measured actual temperature of 23°C (Tactual):

The voltage output is calculated by:

$$Vout = \left[\frac{(Tactual - Tlower)}{(Tupper - Tlower)} \times 5\right]$$

yielding an output voltage of 1.15V.

$$\left[\frac{(23 - 0)}{(100 - 0)} \times 5\right] = 1.15V$$

The current output is calculated by:

$$Iout(mA) = \left[\frac{(Tactual - Tlower)}{(Tupper - Tlower)} \times (20 - 4)\right] + 4$$

yielding an output current of 7.68 mA.

$$\left[\frac{(23 - 0)}{(100 - 0)} \times (16)\right] + 4 = 7.68mA$$

2.4.1a Additional Voltage Outputs

It is possible to use either of the analog current outputs as an additional voltage output by connecting a precision resistor from the current output to its return. A voltage will be produced equal to the output current times the load resistance. To produce a voltage output range of 1 to 5 volts, connect a 250 ohm resistor (0.1% tolerance recommended).

Using a 250 ohm resistor, the voltage output is calculated by:

$$Vout = \left[\frac{(Tactual - Tlower)}{(Tupper - Tlower)} \times (5 - 1)\right] + 1$$

yielding an output voltage of 1.92V for this example.

$$\left[\frac{(23 - 0)}{(100 - 0)} \times 4\right] + 1 = 1.92V$$

2.4.2 Alarm Outputs

Each alarm output connects to the contacts of a 5-Amp, Form C (SPDT) relay.

Make connections as follows:

- For normally open contacts, connect to NO and COM.
- For normally closed contacts, connect to NC and COM.

Any available parameter can be used to control an alarm relay by programming the parameter name and its threshold values. An alarm can also be programmed to monitor the state of the Control, PACER Balance, or Service indicators. (See Chapter 4, 5 or 6 for programming instructions).

Two threshold values are programmed for each parameter—an upper and a lower value. These values designate an alarm band. How they are used depends on the alarm type programmed. Details of the alarm bands are shown on the following pages.

2.4.2a Set Point Alarm

For the **Set Point** alarm type, the alarm band provides hysteresis to prevent frequent operation of the alarm relay when the parameter is near the specified value. The relay is **activated** when the parameter **exceeds** the upper limit, and **deactivated** when the parameter goes **below** the lower limit.

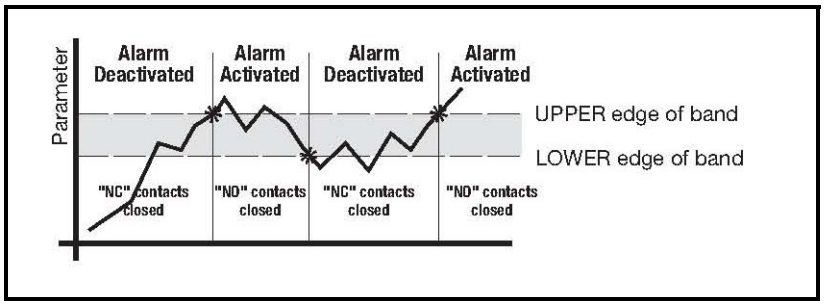


Figure 16: Set Point Alarm

2.4.2b Inner Band Alarm

For the **Inner Band** alarm type, the alarm relay activates whenever the parameter value is **between** the lower and upper limits.

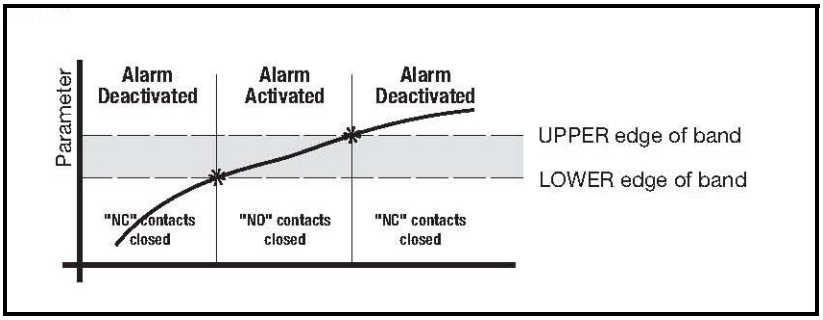


Figure 17: Inner Band Alarm

2.4.2c Outer Band Alarm

For the **Outer Band** alarm, the alarm relay activates whenever the parameter value is **greater** than the upper limit or less than the lower limit.

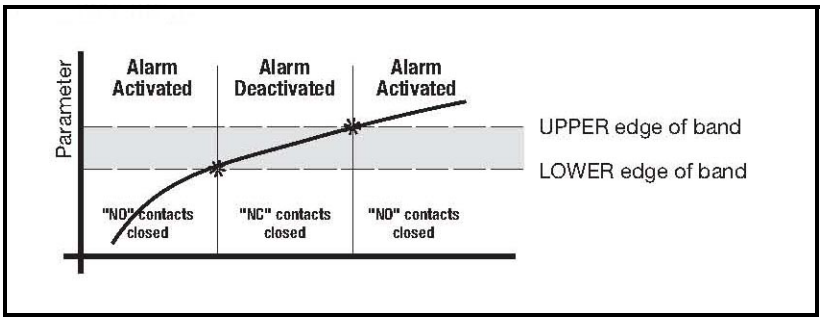


Figure 18: Outer Band Alarm

2.4.3 Serial Output

The Serial Output connector is located at the lower left of the rear panel of the bench-mount unit, and the bottom panel of the wall-mount unit. The output provides RS-232C serial communications between the unit and a terminal or a PC running in terminal emulation mode.

The connector is a standard 9-pin D connector. For connection to another serial device, the cable is wired as shown below. For a basic interface without handshaking, only pins 2, 3 and 5 (RX, TX and GND) on the *Optica* connector are needed. Pin connections are given for both 25-pin and 9-pin devices.

Optica Connector		25-Pin Device		9-Pin Device	
Pin	**Connection**	**Pin**	**Connection**	**Pin**	**Connection**
2	(RX)	3	(TX)	3	(TX)
3	(TX)	2	(RX)	2	(RX)
4	(DTE)	6	(DSR)	6	(DSR)
5	(GND)	7	(GND)	5	(GND)
6	(DSR)	20	(DTE)	4	(DTE)
7	(RTS)	4	(CTS)	8	(CTS)
8	(CTS)	5	(RTS)	7	(RTS)

The baud rate, format of the data, number of stop bits, number of data bits, and parity can all be programmed using the menus.

2.5 Sensor Information

GE Measurement & Control produces a variety of sensors compatible with the Optica, ranging from one to five stages of thermoelectric cooling. A comparison chart listing specifications of each sensor is given in Appendix D. The following sections provide information on installing the following GE dew point sensors:

- Model 1111H — Single-stage sensor
- Model 1211H — Two-stage sensor; for high pressure and temp.
- Model D-2 — Two-stage sensor
- Model SIM-12H — Two-stage heated sensor
- Model 1311DR — Four-stage heated sensor
- Model 1311XR — Five-stage water-cooled sensor

When selecting a location for installing a sensor, consider the following criteria:

- Locate the sensor as close as is practical to the source of the gas to be measured, to keep the sampling lines as short as possible. This minimizes the system response time and reduces the error rate at low frost points due to sample line outgassing.
- Choose a sensor location that provides access to the dewpoint sample cavity cover, to facilitate periodic mirror cleaning.

CAUTION! Never place the sensor in a location where temperatures rise above the maximum rated temperature for the device. See Appendix D for complete sensor specifications.

2.5.1 Sampling Lines

Keep the length of sample tubing between the source and the sensor short, for quick response and highest accuracy.

All sampling line compression fittings provided with the sensor are for ¼-inch diameter tubing, unless otherwise specified at the time of order.

The material used for the inlet lines can have an important effect on the validity of the readings. Do not use rubber hose or plastic tubing such as PVC or Tygon, because of their hygroscopic nature.

When measuring frost points below –30°C, sample gas leaving the sensor outlet should be vented through an additional line three to six feet long, since backflow of ambient moisture into the sensor can take place even under positive pressure. Use stainless steel tubing and fittings, and ensure that all plumbing is completely free from leaks.

At dew/frost points above –20°C, tubing material is not as critical. Copper, PTFE, polypropylene, aluminum or brass tubing and fittings may be used. The sampling system should allow for periodic cleaning. It may be helpful to install a tee and closing valve on the inlet side, to permit the sensor to be shut off while the sampling lines are flushed. At very low humidities, even a trace amount of contamination can alter measured frost point, so cleanliness is particularly important.

2.5.2 Ensuring Heat Transfer

Be sure the sensor has an adequate heat sink when operating in hot environments. The sensor must never be allowed to reach a temperature above its rated limit. It is not sufficient merely to ensure that the sensor is in an environment whose temperature is below the rated limit; a means must be supplied to remove heat from the sensor.

When the Model 1111H or D-2 sensors are used at ambient temperatures of 20° to 24°C, full rated depression can be achieved by mounting the sensor on a smooth, thermally conductive surface (such as metal), which tends to remain at the ambient temperature.

If possible, do not operate the sensor continuously at or near full depression. Doing so may decrease the anticipated life of the thermoelectric heat pump.

2.5.3 High Dew Point Measurements

2.5.3a Using Heated Sensors

When measuring dew points at or above the ambient temperature, the sensor must be heated to a temperature of at least 5 to 10°C above the highest anticipated dew point (but not higher than the sensor temperature rating). Some sensors can be mounted on a liquid heat exchanger, or a temperature-controlled electric hot plate, or installed in a heated enclosure. GE recommends closed-loop active control of the elevated sensor body temperature.

The sensor base should be coated with zinc-oxide-filled silicone thermal grease and securely anchored to the heat sink with suitable fasteners. Allow ½ hour for the sensor to reach thermal equilibrium after adjusting the temperature of the heat sink.

The GE SIM-12H high temperature sensor is designed for high-temperature applications. It measures dew points above ambient temperature without condensation problems.

2.5.3b Sample Lines for High Dew Point Measurements

Sampling lines carrying gas to the sensor must be heated and insulated when the dew point of the gas is above the sample line's ambient temperature. The simplest way to achieve this is to use heater tape (either thermostatically controlled, or continuously operating, and sized to provide the required temperature rise). At high temperatures, use stainless steel tubing with adequate insulation to avoid hot and cold sections in the line and to avoid water absorption/desorption cycling as the heater is thermostatically controlled. Heated sampling lines (HSL) are available from GE Measurement & Control.

2.5.3c Filter Requirements

If the gas to be monitored is free from particulates and hydrocarbon liquids or vapor, filtering is not necessary. However, most sample gas streams contain some particulates, and using a filter reduces the need for frequent mirror cleaning. On the other hand, filtering tends to slow the system's response, particularly at low frost points.

The series 912 filters manufactured by Balston Company (or equivalent) are effective for most applications. For particulates and liquid hydrocarbons, use a Balston type DX filter element.

To filter out very fine particles, the type DX can be followed by a type BX filter. A type CI filter can be used to remove hydrocarbon vapors.

If the sample gas is heavily and routinely contaminated, we recommend using a quick-change filter element. Avoid using glass wool, cellulose, and other hygroscopic materials as a filter medium.

2.5.3d Flow Rate

It is important to have adequate flow through the sensor. Too little flow can slow the response (particularly at very low frost points). Too much flow can cause instability of the control system at high dew points and can reduce the depression capability of the thermoelectric cooler at very low dew points. Too much flow also accelerates the rate of system contamination. A flow rate of 2 to 2.5 ft3/h (a little over 1 liter/min) is ideal for most applications. In many cases, flow rates between 0.2 and 5 ft3/h (0.1 and 2.5 liter/min) may be used.

2.6 Sensor Installation

This section provides installation details for the GE Measurement & Control line of chilled-mirror humidity sensors.

2.6.1 Model 1111H Sensor

The Model 1111H is an open-type sensor (see Figure 19 below). It can be threaded into standard pipe fittings or mounted in a type 0111D pressure boss, which encloses it and adapts it for ¼-inch compression fittings. When installing the sensor in the pressure boss, remove the black aluminum sensor cover.

For maximum thermal conductivity, the base of the Model 0111D pressure boss should be coated with heat-conducting grease. When so installed on a surface suitable for dissipating heat, the sensor will achieve its maximum rated depression. See the *Chilled Mirror Sensor Comparison Chart* in Appendix D.

Figure 19: Model 1111H Sensor

2.6.2 Model D-2 Sensor

The Model D-2 is a general purpose, two-stage sensor with 65°C (117°F) of depression capability. It features wetted parts of stainless steel and glass, for durability in demanding industrial applications. The Model D-2 can be used as a benchtop sensor, mounted to a heat sink, or mounted to a cooling fan for maximum operating range. Advanced features include field-replaceable optics and cooler assemblies, and auxiliary visible light optics with a viewing window for inspecting the mirror during operation (see Figure 20 below).

For maximum thermal conductivity, the base of the Model D-2 sensor should be coated with heat-conducting grease. When so installed on a surface suitable for dissipating heat, the sensor will achieve its maximum rated depression. See the *Chilled Mirror Sensor Comparison Chart* in Appendix D.

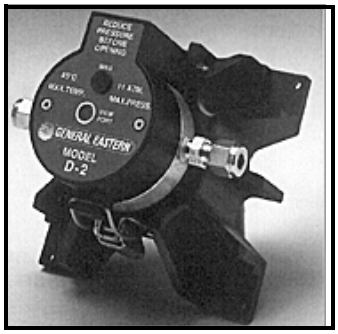


Figure 20: Model D-2 Sensor

2.6.3 Model 1211H Sensor

The Model 1211H is a two-stage sensor with 65°C (117°F) of depression capability. It features wetted parts of stainless steel and may be used at higher temperature and pressure than the D2 sensor. The Model 1211H can be used as a benchtop sensor, mounted to a heat sink. Features include a field-replaceable mirror, optics and cooler assembly. See the *Chilled Mirror Sensor Comparison Chart* in Appendix D.

2.6.4 Model 1311DR Sensor

The 1311DR is a stainless steel, liquid cooled, four-stage sensor suitable for measuring dew points between –75°C and +25°C.

Mount the 1311DR sensor so that the air inlet and exhaust openings are free from obstruction (see Figure 21 below). If the sensor is liquid cooled, vertical wall mounting is recommended, observing the "UP" arrow on the case. This ensures that condensation forming on cold portions of the 1311DR will drain from the enclosure.

At room temperatures (25°C) with air cooling, dew points from –65°C to +25°C can be measured. When operating it without liquid cooling, switch on the built-in fan. For lower frost point measurements, a chilled-water coolant loop can be used for cooling. Make sure the fan switch is off when using liquid cooling.

Sample flow rates from 0.5 to 5 standard cubic feet per hour
(0.25 to 2.5 liters per minute) should be used.

CAUTION! If it can be avoided, do not operate the sensor continuously at or near full depression. Doing so may decrease the life of the thermoelectric heat pump.

Liquid cooling is required for measuring frost points below –65°C (at 25°C ambient), and may be used to create faster response at higher dew point temperatures. If a recirculating chiller is used, it should have a capacity of at least 300 watts at the coolant temperature. Switch the internal fan ON if air cooling is used; leave it OFF for liquid cooling. Install the gas sampling lines according to the instructions listed in the section *Sampling Lines* on page 21.

Figure 21: Model 1311DR Sensor

2.6.5 Model 1311XR Sensor

The 1311XR is a stainless steel, water cooled, five-stage sensor (see Figure 22 below) that can measure frost points as low as –80°C. The sample gas flow rate should be between 1 and 5 ft^3/h. The maximum permissible coolant temperature is +50°C; the minimum is –10°C. A minimum coolant flow rate of 0.1 gallons per minute must be maintained for most dew point measurements. If the fourth stage power supply control is set below –65°C, the minimum coolant flow rate is 0.25 gal/min. The coolant temperature affects the maximum dew/frost point depression. For frost points of –80°C, coolant temperature should be below 20°C.

Figure 22: Model 1311XR Sensor

2.6.5a Electrical Connections

All the electrical connectors on the Model 1311XR dew/frost point sensor are unique. The cables supplied with the sensor can only interconnect the system in one way. Connect the cables as follows:

1. Plug the instrument into a 115/230 VAC power outlet.
2. Connect the 37-pin round black connector on the back of the instrument to the 19-pin military-style connector on the back of the 1311XR sensor.
3. Connect the 17-pin military style connector on the back of the 1311XR sensor to the 24-pin round connector on the back of the heat pump controller module.
4. Connect the 9-pin round connector on the back of the heat pump controller module to the 8-pin rectangular connector on the back of the fourth stage heat pump power supply.
5. Plug the heat pump power supply into a 115/230 VAC outlet.

2.6.5b Coolant

Connect the two 3/8-inch brass compression fittings on the back of the 1311XR sensor to the coolant lines. Do not run the instrument without sufficient coolant flow.

Suitable coolants include water, glycol and other noncorrosive liquids. The coolant can be recirculated liquid or tap water that is cooled or chilled. If a recirculating chiller is used, it should have a capacity of at least 600 watts at the coolant temperature.

2.6.5c Sample Gas Fittings

The 1311XR sensor has 1/4-inch stainless steel compression fittings for sample gas inlet and outlet at the back of the sensor chassis.

2.6.5d Heat Pump Controller Settings

The 1311XR's heat pump controller module has the following settings:

Table 1: Model 1311XR Heat Pump Controller Settings

Setting	Function
AUTO	When set to **AUTO**, the system operates fully automatically, controlling the heat pump in response to any dew/frost point within its operating range. In **AUTO** mode, the controller senses the current supplied by the Optica to the top two stages of the thermoelectric coolers. The controller switches on the fourth stage power supply, as required to maintain the mirror temperature at the dew/frost point. The **AUTO** setting is recommended for most applications.
Below –55°C	If the frost point is known to be below –55°C, the switch can be set to this position to provide slightly faster response than the **AUTO** setting. However, depression is limited at this setting. If frost points approaching –80°C are to be measured, use the **AUTO** setting.
–65°C to –10°C	If the dew/frost point is known to be between –65°C and –10°C, the switch can be set to this position to reduce overshoot and settling time.
Above –25°C	If the dew/frost point is known to be above –25°C, the switch can be set to this position to reduce overshoot and settling time.

Note: *The third-stage power indicator may blink in any setting. This is normal.*

2.6.5e Fourth-Stage Power Supply Control Knob

The control knob on the 1311XR's fourth-stage power supply sets the power consumption limit and the coolant requirement when measuring dew/frost points using the AUTO or BELOW –55°C settings. Set this knob to the lowest anticipated dew/frost point.

If the control is set lower than necessary, the system dissipates excess power and requires additional cooling to remove the extra heat generated. If the setting is too high, the system may not be able to reach the true dew/frost point.

To allow the 1311XR sensor to act as a turnkey system (whereby it will cover its entire range automatically), set the switch to **AUTO** and the power supply control knob to the –80°C position.

2.6.5f Heat Pump Controller Error Indicators

The heat pump controller module has two overheat indicators connected to thermal shutdown switches. If either indicator comes on, check for and correct any problems before continuing operation. Check the cable connections, coolant flow and coolant temperature.

2.6.5g Purging the Sensor

CAUTION! The 1311XR must be purged after each use, either with the sample gas after measuring it, or with another dry gas source. Otherwise, condensation inside the sensor housing may cause corrosion and eventual failure of the thermoelectric coolers.

For extremely dry gas measurements, the 1311XR sensor enclosure must be purged with a gas having a frost point lower than –20°C. For intermediate temperatures, any gas having a frost point at least as low as the sample gas can be used.The sample gas outflow from the sensor can be used for this purpose, if it is suitable (non-explosive, non-lethal, etc.). Introduce the purge gas to the enclosure via the purge fitting on the rear of the sensor. The simplest method for purging is to run the sample gas outflow through the U-tube supplied with the sensor.

2.6.6 Model SIM-12H Heated Sensor and Components

The SIM-12H heated sensor module is suitable for measuring dew/frost points between –10°C and +85°C. It contains precision heating, as well as cooling, capability. Three separate heaters are located in the sensor walls, 120 degrees apart. Three temperature sensors measure the body temperature at those points, and three control circuits precisely adjust the temperature of each heater. Any detected temperature gradient across the sensor cavity is immediately eliminated, resulting in very even control. All three heaters are controlled by the temperature set by the front panel selector knob. The sensor is a two-stage unit, providing 65°C of depression capability, and 60°C actual measurement range.

2.6.6a Type SIM-HFT Heated Filter Module

The SIM-HFT heated filter module allows the sample gas to be purged of particulate contaminants prior to entering the sensor.
The incoming gas is first passed through a 90-micron prefilter, then a 15-micron final filter. All parts in contact with the sample are heated to a constant 105°C, eliminating any possibility of condensation. The sintered filters are easily removed for cleaning or replacing if required.

2.6.6b Type SIM-HFM Heated Flow Meter

The SIM-HFM heated flow meter module allows the sample gas flow rate to be both measured and controlled at a rate that is optimum for the sensor. A metering valve mounted on the front panel allows control over a range of 0 to 2 ft^3/h. All parts in contact with the sample gas are heated to a constant 105°C, so that no condensation occurs. The flow meter is normally mounted downstream from the heated sensor.

2.6.6c Type SIM-HSL Heated Sampling Line

The SIM-HSL heated sampling line is self-regulated at a temperature high enough to ensure that no condensation occurs. The line is made of ¼-inch outside diameter PTFE, with stainless steel fittings.

2.6.6d Type SIM-MPL Mounting Plate

The SIM-MPL mounting plate is designed to accept one, two or three heated modules: the heated sensor, the heated filter, and the heated flow meter. The mounting plate provides a convenient method of wall-mounting the entire heated sampling system. When ordered with one or more modules, the factory performs all mounting, plumbing and wiring work, thus providing a complete system ready for installation.

2.6.7 Connecting the Sensors

Dew point, temperature and pressure sensors provided by GE for the Optica monitor are pre-wired with connectors installed. Plug these connectors into their corresponding sockets as shown in Figure 9 on page 13 for the benchtop unit, or Figure 12 on page 15 for the wall-mount unit.

Chapter 3. Operation

3.1 Introduction

Operating instructions fall into three categories:

- Normal Operation - Using the unit's controls.
- Setup and Programming - Customizing the unit for specialized applications (not required for many conventional applications).

Note: *The unit is shipped pre-programmed to meet typical requirements. The factory default settings are listed in Table 3 on page 37. Complete programming instructions are given in Chapters 4, 5, and 6.*

- Maintenance - Manually testing the unit's cooling capacity, cleaning the mirror, and other operations that might be required on a regular basis, or when a problem is suspected, depending on the application. Details are given in Chapter 7, *Maintenance*.

3.2 Normal Operation

Normal operation of the Optica is very simple. To turn the unit on, check that the main power switch on the rear of the benchtop unit is set to **ON** (—), then press the right-hand side of the power switch (located at the lower left corner on the front of the unit).

The Optica begins its power-up sequence, which lasts about a minute. The unit's software version is displayed on the initial screen. The status line displays Initializing. Next, the Optica performs a PACER balance. The PACER balance typically requires five to fifteen minutes, depending on the sensor chosen and the humidity of the sample gas during the balance cycle. The status line displays Balance Acquiring.

Once the balance cycle is completed and the unit reaches steady state, Control is displayed in the status bar at the bottom of the screen.

The sensor can be controlled using the softkeys to the right of the display, shown on the screen in Figure 23 on page 30. The operator can manually heat or cool the sensor, or initiate a PACER balance cycle.

3.3 Operating the VGA Optica

The parameters chosen during programming are displayed numerically in the top half of the screen, and graphically at the bottom (see Figure 23 below). To program the unit, see Chapter 4.

A balance indicator is shown as a vertical bar on the right side of the screen. It shows the state of the feedback control loop controlling the mirror temperature. When the system reaches steady-state (the Control status indicator is displayed), the balance indicator should be near the center of its range. If the balance indicator is near the top or bottom of its range, the dew point sensor may need to have its optics signal level adjusted (see *Minor Maintenance of Sensor Optics* on page 77).

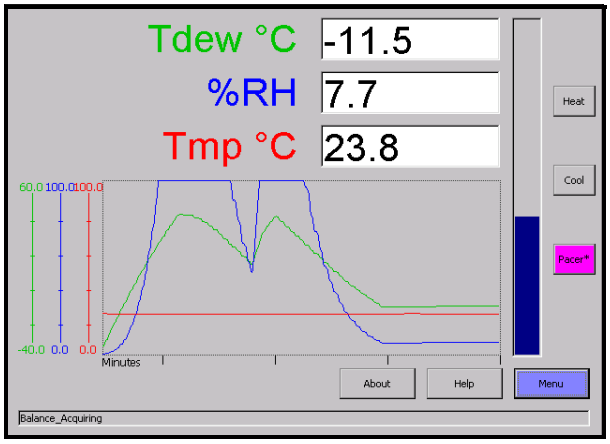


Figure 23: Typical VGA Display Screen

3.4 Operating the 4x40 Optica

The parameters chosen during programming are displayed numerically on the top three lines of the display. For programming, see Chapter 5. A typical 4x40 display screen is shown below. The system status is shown in the lower left, and the balance indicator is shown in the lower right.

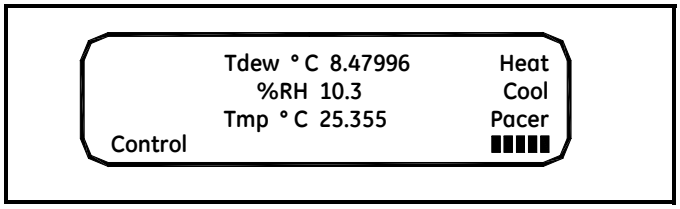


Figure 24: Typical 4x40 Display Screen

3.5 Network Operation

The VGA Optica can be operated and programmed remotely over a network. Networked operation is very similar to operation using the front panel. For programming from a network, see Chapter 6. A typical network screen is shown in Figure 25 below.

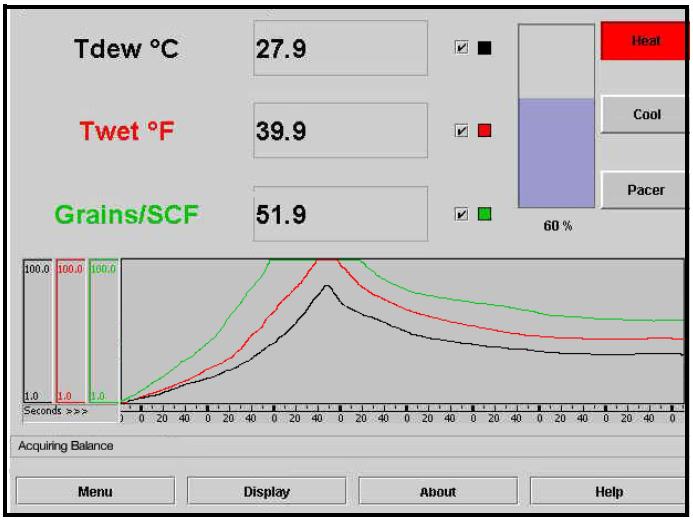


Figure 25: Typical Network Screen

3.6 Process Pressure

The Optica provides several ways of measuring or specifying sample gas pressure (needed for pressurized humidity measurements). You can:

- actively measure the pressure at the dew point sensor, or
- manually enter the pressure, if it is known and stable, or
- "sample-off" a high-pressure gas sample for measurement at a lower pressure (usually atmospheric) and let the Optica calculate dew point at the process pressure.

  For example: a sensor with a maximum pressure rating of 300 psi cannot be subjected to a process pressure of 500 psi. A sampling system can be arranged to allow the measurement to be made at atmospheric pressure. The Optica can then calculate and display the dew point at the process pressure (see Scenario 2 on page 34).

3.6.1 Actively Measuring Process Pressure

Use when the process pressure is within the specifications of the dew point sensor and can be measured directly. In the Pressure Input menu, set the Pressure Input to V or I as appropriate for the pressure sensor. Set the Process Pressure Status to Disabled.

Note: *The pressure measured by the pressure sensor will be used to compute the vapor pressure.*

3.6.2 Manually Entering Pressure

Use when the process pressure is a known and fixed value, and will not be actively measured. In the Pressure Input menu, set the Pressure Input to Use Default. Enter the pressure into the Default field. Set the Process Pressure Status to Disabled.

Note: *The default pressure entered will be used to compute the vapor pressure.*

3.6.3 Measuring at a Different Pressure

Use when: the humidity must be measured at a pressure that is lower or higher than the process pressure, but the reported value must represent the humidity at the process pressure. Scenario 2 below gives examples of programming the Optica for this case.

Note: *The process pressure is entered manually and the humidity sensor pressure may be measured or manually entered.*

Examples of the use of the Process Pressure menu are shown

3.6.4 Scenario 1: Measurement Without Enabling the Process Pressure Feature

Process pressure is 100 psi, within the range of a typical GE chilled mirror sensor. Since vapor pressure and dew point are pressure-dependent, a flow meter is installed downstream of the sensor to assure that the sensor cavity is at the process pressure (see Figure 26 below).

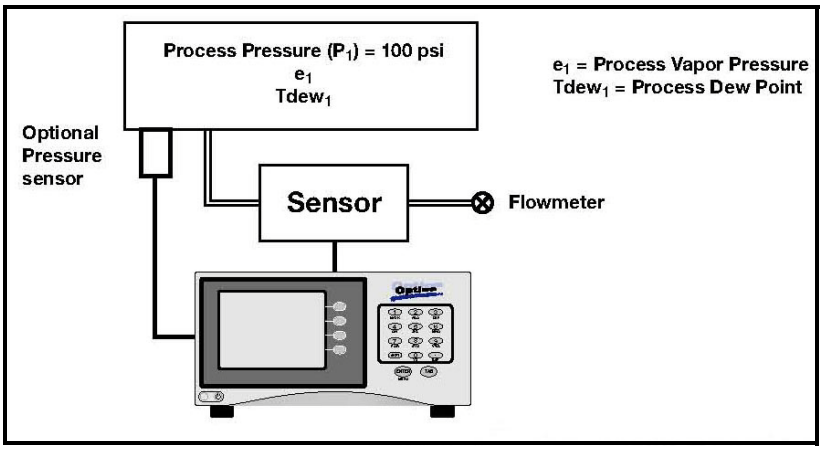


Figure 26: Measurement Scenario 1

3.6.4a Measuring Vapor Pressure Without a Pressure Sensor

To measure vapor pressure without a pressure sensor, make the following entries in the Pressure Input menu section for this example:

- Input: Use Default
- Units: psia
- Default: 100
- Process Status: Disabled

3.6.4b Measuring Vapor Pressure With a Pressure Sensor

To measure vapor pressure with a 4-20 mA, 0-30 psia pressure sensor, connect the sensor to the Optica's terminal block and make the following entries in the Pressure Input menu:

- Input: In 4-20
- Units: psia
- Upper: 30.00
- Lower: 0.00
- Process Status: Disabled

3.6.5 Measuring Dew Point

In this scenario, dew point can be measured without knowledge of gas pressure. Connect the equipment as shown above, with or without a pressure sensor, and follow the normal operating procedures.

3.6.6 Scenario 2: Measurement Requiring the Process Pressure Feature

Process pressure is 500 psi, above the measurement range of a typical GE chilled mirror sensor. A flow meter is installed upstream of the sensor cavity to expand the gas to be within the measurable range of the dew point sensor. Since we wish to measure the dew point of the process gas and dew point is pressure dependent, an accurate dew point measurement at the process pressure requires accommodating for the expansion to the sensor cavity pressure by using the Optica's Process Pressure feature (see Figure 27 below).

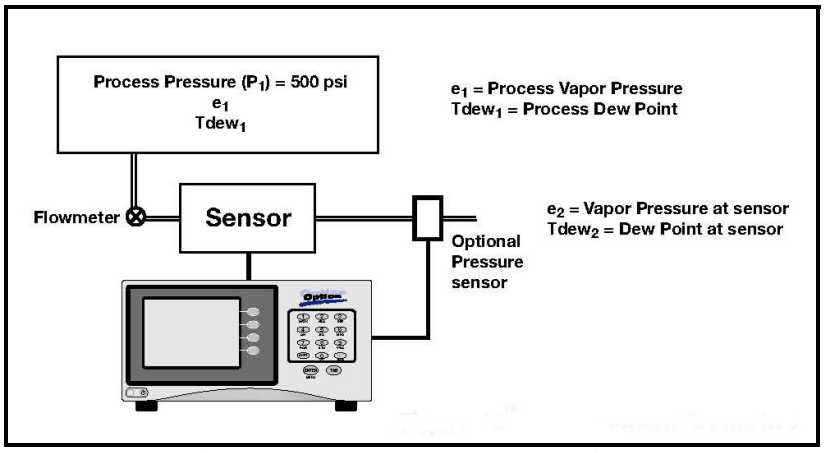


Figure 27: Measurement Scenario 2

3.6.6a Measuring Vapor Pressure Without *a Pressure Sensor*

To measure vapor pressure without a pressure sensor, make the following entries in the Pressure input menu section for this example:

- Input: Use default
- Units: psia
- Default: 14.7 (the pressure at the dew point sensor)

In addition, to accommodate the pressure expansion, the following entries are required in the Process section:

- Status: enabled
- Pressure: 500 (specify the process pressure with the same units as the default pressure specified above)

3.6.6b Measuring Vapor Pressure With a Pressure Sensor

To measure vapor pressure with a 4-20 mA, 0-30 psia pressure sensor, connect the equipment as shown above and make the following entries in the Pressure Input menu section.

- Input: In 4-20
- Units: psia
- Upper: 30.00
- Lower: 0.00

In addition, to accommodate the pressure expansion, the following entries are required in the Process section:

- Status: enabled
- Pressure: 500 (specify the process pressure with the same units as the default pressure specified above)

3.6.6c Measuring Dew Point With or Without a Pressure Sensor

In Scenario 2, the dew point measurement requires both the sensor pressure and the process pressure to be known. Sensor pressure can be entered as a default value, or measured, as above, and the process pressure must be entered in the Process Pressure field.

Example (using standard atmospheric conditions at 25°C)

$$P1 = 500 \text{ psia}$$
$$P2 = 14.7 \text{ psia}$$

As measured by the GEI chilled mirror dew point sensor:

$$Tdew2 = –40°C \text{ @ } P2$$
$$e2 = 0.1283 \text{ mbar}$$

Per Dalton’s Law of Partial Pressure:

$$e1 = (P2/P1) \times e2 = (500/14.7) \times 0.1283 = 4.36 \text{ mbar}$$

Using standard vapor pressure equations, the actual pressurized dew point is calculated by the Optica to be:

$$Tdew1 = –4.022°C$$

3.7 Status Line Indications

The status line at the bottom of the display shows whether the unit is ready for normal operation, or is still in its start-up phase, or needs service. The following is a complete list of status indications:

Table 2: Status Indications

Indication	Meaning
Initializing	The unit is initializing.
Balance	The unit is performing a PACER balance to clear the mirror.
Acquiring	The unit is acquiring stable mirror temperature.
Service	The sensor optics require service, cleaning or adjustment.
Control	The unit is actively controlling the mirror temperature at a stable dew point.
Alarm 1	Alarm 1 has activated.
Alarm 2	Alarm 2 has activated.
Lockout	Heat, Cool, and PACER front panel controls are disabled.
Heat	Sensor Heating is active.
Cool	Sensor Cooling is active.

3.7.1 Factory Default Settings

As shipped from the factory, the Optica is normally programmed with the configuration shown in Table 3 below.

Table 3: Factory Default Values

Function	Setting
Analog Output A Analog Output B	Humidity, *Units:* Tdew °C, *Range:* –40°C to +60°C Temperature, *Units:* Tmp °C, *Range:* 0 to 100°C
Pressure Input 1	*Units:* psia, *Range:* 0–30, *Default pressure:* 14.70, *Process pressure:* disabled, 14.70
Alarm 1 Alarm 2	Disabled, Humidity, *Units:* Tdew °C, *Set Point:* 100.00 Disabled, Temperature, *Units:* Tmp °C, *Set Point:* 100.00
Auto Balance	*Interval:* 720 minutes, Automatic, Disabled, Hold
Data Field 1 Data Field 2 Data Field 3 Data Field 4 Data Field 5 Data Field 6	Humidity, *Units:* Tdew °C, *Range:* –40.000 to +60.000°C, *Color:* green, 1 decimal Humidity, *Units:* %RH, *Range:* 0 to 100, *Color:* blue, 1 decimal Temperature, *Units:* Tmp °C, *Range:* 0 to 100, *Color:* red, 1 decimal Pressure, *Units:* psia, *Range:* 0 to 100, *Color:* yellow, 1 decimal Humidity, *Units:* ppmv, *Range:* 0 to 1,000,000, *Color:* brown, 1 decimal Humidity, *Units:* ppmw, *Range:* 0 to 100, *Color:* violet, 1 decimal
Buzzer	15 msec
General	*Data Fields:* 3, *Lockout:* disabled, *Offsets and filters:* 0
Special	*Molecular Weight of Gas:* 28.9645
User Equation	None entered
Communication Parameters	*Mode:* All, *Baud rate:* 9600, *Parity:* none, *Data bits:* 8, *Stop bits:* 1, *Flow control:* none
Serial Outputs	**Humidity:** *Units:* Tdew °C, *Format:* DP=##.#, *Separator:* CR-LF, *Terminator:* CR-LF, *Interval:* 1 second, *Time Stamp:* Enabled, *Show Status:* Enabled **Temperature:** *Units:* Tmp °C, *Format:* DP=##.#, *Separator:* CR-LF, *Terminator:* CR-LF, *Interval:* 1 second, *Time Stamp:* Enabled, *Show Status:* Enabled **Pressure:** *Units:* psia, *Format:* DP=##.#, *Separator:* CR-LF, *Terminator:* CR-LF, *Interval:* 1 second, *Time Stamp:* Enabled, *Show Status:* Enabled
Selected Outputs	Humidity, *Units:* Tdew °C Humidity, *Units:* % RH Temperature, *Units:* Tmp °C
Data Log	*Status:* Disabled, *Interval:* 1 second, *Separator:* comma, *Terminator:* CR-LF, *Parameters:* humidity, *Units:* Tdew °C

3.8 Sensor Balancing

During normal operation, the sensor mirror surface may become partially obscured with salts or other contaminants from the sample gas. The balance indicator displayed on the screen shows whether the system is operating near the center of its normal range, or has been forced away from the center by mirror contamination. In general, it is recommended to start with an AUTO balance cycle provided relatively clean gases are being used. If the Service status indicator is displayed after an AUTO cycle, the mirror is likely still dirty and may require use of a PACER cycle (described in detail on page 7). In most applications, it is desirable to perform a balance operation periodically to maintain optimum performance. The interval and type of balance are configurable as described in the Optica programming chapters.

If the Service indicator is displayed after a balance operation, the sensor may need to be adjusted (see *Minor Maintenance of Sensor Optics* on page 77).

3.9 Helpful Hints For Operating the Unit

Time response: At dew points above 0°C, the system stabilizes within a few minutes at a consistent dew layer. The status **Control** is displayed when the system is stable and readings are valid.

When the system is operating at low frost points (below –40°C), extra care may be required when interpreting readings because of the longer response times of the system. Time response depends on a number of factors including dew/frost point, slew rate, upstream filtering, and flow rate.

- As the dew/frost point becomes lower, water molecules in the air sample become scarcer, and it takes longer to condense a frost layer on the mirror thick enough to establish an equilibrium condition.
- Mirror temperature slew rate depends on dew point and depression (the temperature difference between the mirror and the sensor body); at higher dew points and moderate depressions, it is typically 1.5°C/second. At lower dew points and/or larger depressions, the slew rate is slower.
- Flow rate affects response by determining the rate at which water vapor is supplied or carried off.

There is, of course, a trade-off between response time, control system stability, and sensitivity to contamination.

3.9.1 Supercooled Dew Points

Slightly below the freezing point, water can exist in a supercooled liquid state for extended periods of time. Extra care may be needed when making measurements in the frost point region of 0 to –20°C, because the mirror temperature may temporarily stabilize at the supercooled dew point, 0.5 to 1°C below the actual frost point.

To assure that the unit is operating in the ice phase within this temperature range, allow the instrument to operate continuously. Before manually clearing a frost layer, take a reading, and afterwards allow sufficient time to reform a stable frost layer before taking further readings.

3.9.2 Contamination

3.9.2a Mirror Cleanliness

Proper operation of a condensation hygrometer depends on the condition of the mirror surface. In general, accuracy is reduced when contaminants accumulate on the mirror.

However, the mirror does not have to be microscopically clean. In fact, the mirror performs best a few hours after cleaning, when nucleation sites have formed. On an unscratched, freshly cleaned mirror, there are relatively few nucleation sites on which dew or frost deposits can form, and more time is required to collect a condensation layer at low frost points. Also, overshoot may occur, which can cause oscillations as the temperature stabilizes.

3.9.2b Particulate Contaminants

Particulate matter that is insoluble in water may accumulate on the mirror surface, but does not affect the instrument accuracy until the mirror reflectance is reduced substantially. In many cases, particulates improve instrument response by providing condensation sites.

3.9.2c Water-Soluble Contaminants

Contaminants which readily dissolve in water, such as naturally occurring salts, are detrimental to accurate vapor concentration measurement by any condensation method. These materials readily go into solution with the water condensate on the mirror surface, and then reduce the vapor pressure in accordance with Raoult's Law. As the concentration increases with time, the saturation vapor pressure of the liquid solution decreases.

The unit responds to this lower vapor pressure by elevating the mirror temperature in order to maintain a vapor pressure that is in equilibrium with the partial pressure of atmospheric water vapor. The displayed dew point, therefore, drifts upward above the true dew point. Because the measurement error increases gradually, it often goes undetected.

To determine whether dissolved contaminants are affecting dew point measurement, perform the following steps:

1. Note the indicated dew point.
2. Clean the mirror.
3. Balance the detector by initiating a PACER cycle.
4. Measure the dew point again.

If the new reading is lower than the first reading, it is likely that soluble material was present in sufficient quantity to cause a measurement error.

3.9.2d Gaseous Contaminants

When a gaseous material that has a higher condensation temperature than that of water is present (even in very low concentrations), the unit will eventually control on that material, rather than on water. The system then displays the condensation temperature of the contaminant, not of water. Such material accumulates on the mirror only when chilled. In the normal atmosphere, gaseous contaminants do not have a detectable effect.

3.9.2e Minimizing the Effects of Contaminants

The following steps are suggested for maintaining optimum performance:

- Use the PACER feature to reduce the effect of contaminants on the unit's performance (see *The PACER Cycle* on page 7).
- Reduce the gas flow rate to reduce the rate of accumulation of contaminants on the mirror.
- Clean the mirror according to the recommended optics cleaning procedure (see *Minor Maintenance of Sensor Optics* on page 77). To determine the proper cleaning interval for a given set of conditions, take a dew point reading before and after the cleaning. Any appreciable shift indicates that under these conditions, the mirror should be cleaned more often.

3.9.3 Mirror Flooding

If there is an abrupt transition from dry to moist conditions (particularly when accompanied by a transition from cold to warm temperatures), the mirror may accumulate an overload of moisture. It then may take several minutes before the sensor dries out and valid readings can be obtained. The drying process can be accelerated by heating the sensor.

3.9.4 Sample Line Maintenance

Contaminated sample lines slow the unit's response time and can cause erroneous readings, usually on the high side. Clean the sample lines as often as necessary. To determine the required cleaning frequency, take dew point readings before and after cleaning the lines, sensor cavity, and mirror. If the two readings differ appreciably, the sampling lines should be cleaned more often. To reduce the rate of contamination, reduce flow and/or install a filter upstream.

3.9.5 Pressure Effects

If the pressure of the gas is increased or reduced from atmospheric pressure, but the mixing ratio (moisture content) stays constant, the dew point is correspondingly increased or decreased. The Optica displays the dew/frost point at the pressure to which the sensor chamber is exposed. The sensor location and hookup arrangement can influence the pressure.

When the pressure at the sensor is different from the process pressure, the Optica can perform a conversion from the measured pressure to the desired process pressure (see *Process Pressure* on page 32 for details).

Alternatively, the dew point change due to pressure change can be calculated by using Dalton's Law and the Smithsonian Tables or a proper nomograph. Appendix C contains basic data for these calculations.

Chapter 4. Programming the VGA Optica

4.1 Introduction

The Optica is programmed at the factory to display and output the data required for many applications (see Table 3 on page 37). In these cases, no further programming is required.

By programming the Optica, the following categories of data can be customized for your application:

- the front panel display (up to six parameters displayed numerically and, on the VGA screen, a graphical display)
- pressure input
- analog outputs
- serial output
- built-in alarms
- datalogging
- miscellaneous functions

A built-in help system is included to answer questions you may have while operating the unit. Select the **HELP** button and press **ENTER** to access it.

4.2 Programming Fundamentals

Programming is accomplished using two main menu screens and several secondary screens. Each screen displays data fields and control buttons. Use the **TAB** key to step through the fields on each screen—through both the data fields and the control buttons.

- When a data field is selected, you can change the value of the field as described on page 42.
- When a control button is selected, pressing **ENTER** performs the button's function.
  - The **MORE** control button accesses the next programming menu.
  - The **OK** control button returns to the previous level.
  - The **HELP** button accesses the unit's built-in help system.

4.2.1 The Keys

The following keys on the Optica's front panel are used for programming:

- **ENTER** Performs the function shown on a selected control button.
- **TAB** Moves cursor to the next field or control button to select it.
- **SHIFT** An alternate action key—each press toggles SHIFT-KEY mode on or off. When SHIFT-KEY mode is on, a green annunciator is displayed in the lower left corner of the screen. SHIFT-KEY mode does the following:
  - accesses the alphabetic characters below the keys on the alphanumeric keyboard.
  - causes the **TAB** key to move the cursor **backwards** through the fields.
- **Ten alphanumeric keys** For entering numbers, letters and math functions.
- **BSP** (Backspace) During direct data entry, deletes the character to the left of the cursor.
- **Four softkeys**:
  - during normal operation, control the sensor heating and cooling, and balance function.
  - during programming, move the cursor on the screen and select specific characters for each key on the alphanumeric keyboard.

4.2.2 Data Entry Fields

There are two types of data entry fields:

- direct entry
- drop-down boxes

4.2.2a Direct-Entry Fields

Direct-entry fields allow new values to be entered directly from the alphanumeric keyboard. Use the left and right softkeys to move the flashing cursor on the screen to the desired character.

- To enter **numeric** data, just press the appropriate key.
- To enter **alphanumeric** data, first press **SHIFT** to access the letters on the keypad, and then press the appropriate key containing the desired letter. Finally, press the **UP** or **DOWN** arrow softkeys to step through the letters available for that key, both upper and lower case.

4.2.2a Direct-Entry Fields (cont.)

Note: *It is NOT necessary to press ENTER after setting each value into its field.*

Figure 28 below shows a typical direct-entry field, with the **GrphMin** (Graph Minimum) field selected and ready for numeric input from the keypad.

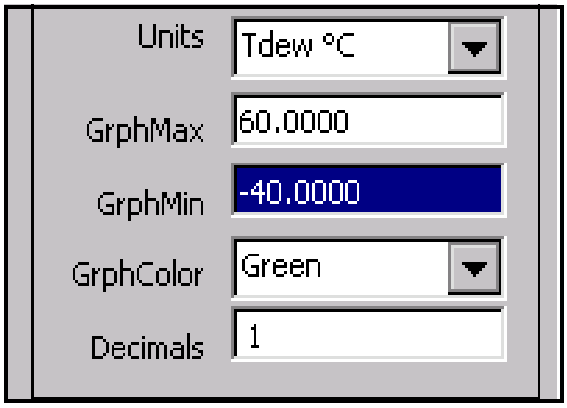


Figure 28: Typical Direct-Entry Field

4.2.2b Drop-Down Boxes

Most programming is done using drop-down boxes that allow the user to select from a list of possible choices for the field.

First, select the field with the TAB key. A drop-down list showing the available options opens immediately below the selected field. Be careful not to confuse this drop-down list with other fields below the selected one—they look similar. Use the UP and DOWN arrow softkeys to select the desired value for the field. When finished, press TAB to move to the next field.

Figure 29 below shows a drop-down entry box, with the **GrphColor** (Graph Color) field selected and ready for choosing the desired color using the **UP** and **DOWN** arrow softkeys.

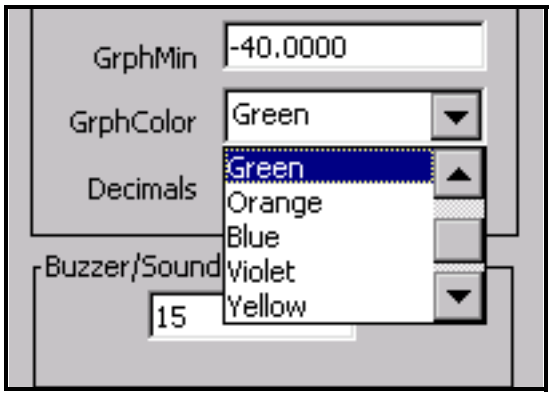


Figure 29: Typical Drop-Down Box

4.3 Units of Measure

Table 4 below shows the units of measure available for each parameter:

Table 4: Available Units of Measure

Parameter	Available Units
Humidity	Tdew °C, Tdew °F, %RH, Twet °C, Twet °F, ppmv, ppmw, Grains/lb, Grains/SCF, g/kg, g/m^3, lb/mft^3, kj/kg(0), kj/kg(32), BTU/lb(0), BTU/lb(32), pw (mbar)
Temperature	Tmp °C, Tmp °F, Tmp °K, Tmp °R
Pressure	psia, mbar, bar, Pa, kPa, mmHg, inHg, kg/Cm^2, Dyne/Cm^2

4.4 User Equations

In some applications an output may be needed that is not a simple function of a single parameter, but a combination of two or three. One or more user equations can be defined within the Optica to calculate new parameters that meet the application's requirements. The equation can be formed from following elements:

- the identifiers for the measured or derived parameter units (listed in Table 5 on page 45).
- the math operators +, –, ×, /, **(,)** and ^ (accessed through the math key in SHIFT mode)
- the math functions LOG and LN
- constants
- other user equations

The new parameter defined by this equation is given a name and can be displayed or output just like any other parameter.

User Equations are entered from Menu 2 (see page 55). A list of parameters and other elements is displayed. Each element is specified by an identifier such as "A1." Use these identifiers to form the equation. In addition, another user equation can be used as an equation element by entering its identifier.

4.4 User Equations (cont.)

Table 5: User Equation Parameters

Identifier	Units	Identifier	Units
Humidity Units:		**Temperature Units:**	
A0	Tdew °C	A17	Tmp °C
A1	Tdew °F	A18	Tmp °F
A2	%RH	A19	Tmp °K
A3	Twet °C	A20	Tmp °R
A4	Twet °F	**Pressure Units:**	
A5	ppmv	A21	PSIA
A6	ppmw	A22	mbar
A7	grains/lb	A23	bar
A8	grains/scf	A24	Pa
A9	g/kg	A25	kPa
A10	g/m3	A26	mmHg
A11	lb/mft3	A27	inHg
A12	kj/kg(0)	A28	kg/cm2
A13	kj/kg(32)	A29	Dynes/cm2
A14	BTU/lb(0)	A31	User Equation 1
A15	BTU/lb(32)	A32	User Equation 2
A16	pw(mbar)	A33	User Equation 3

The equation 2 × Tdew °F + (%RH / Twet°C) would be entered as 2 × A1 + (A2 / A3)

4.5 Menu 1

The first menu is shown in Figure 30 below. This menu is accessed by selecting the **Menu** control button on the main screen and pressing **ENTER**.

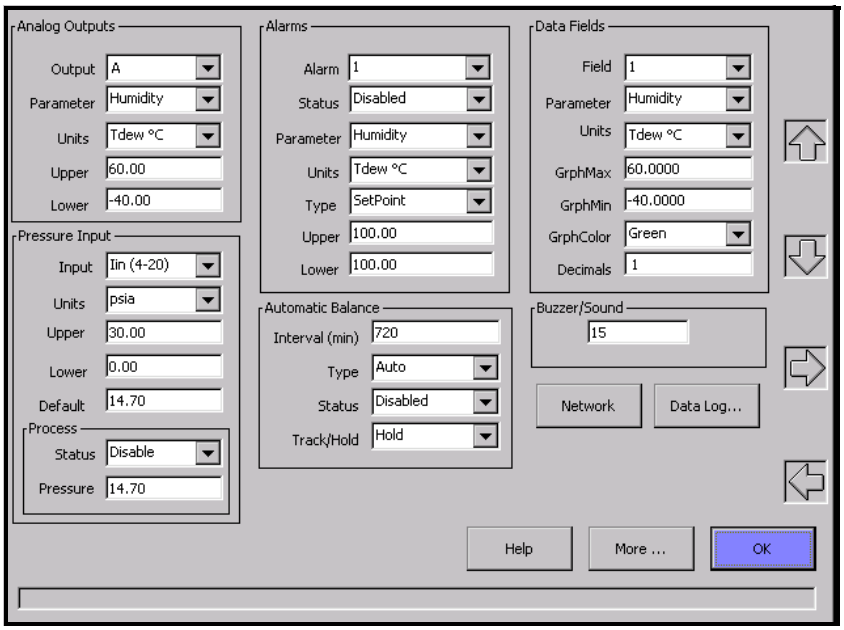


Figure 30: Menu 1

Menu 1 allows programming of the following items:

4.5.1 Analog Outputs

For more information on using the analog outputs, see *Analog Outputs* on page 17.

Table 6: Analog Output Options

Item	Function	Available Options
Output	Choose which output channel is being programmed	A and/or B
Parameter	Choose which parameter will be output on the selected channel	Humidity, Temperature, Pressure or User Equation
Units	Choose the units for this parameter	(See Table 4 on page 44 for the parameter chosen)
Upper Limit	Set the parameter value that will produce full-scale output	(Enter a number)
Lower Limit	Set the parameter value that will produce zero output	(Enter a number)

4.5.2 Pressure Input

For more information on using these items, see *Process Pressure* on page 32.

Table 7: Pressure Input Options

Item	Function	Available Options
Input	Choose which pressure input channel is in use, or disable this input.	V in (0-5), I in (4-20), or Use Default
Units	Choose the units for the pressure input.	(See Table 4 on page 44 for parameter chosen.)
Upper Limit	Set the pressure that corresponds to full-scale input.	(Enter a number.)
Lower Limit	Set the pressure that corresponds to zero volts or 4 mA input.	(Enter a number.)
Default	Pressure value to be used if the measured input is disabled.	(Enter a number.)
Process	*Enter a process pressure when it is different from the pressure at the dew point sensor (see page 32).*	
Status	Set whether the process pressure is active (enabled).	Enable/Disable
Pressure	Enter the process pressure, if this feature is enabled.	(Enter a number.)

4.5.3 Alarms

For more information on using the alarms, see *Alarm Outputs* on page 18.

Table 8: Alarm Options

Item	Function	Available Options
Alarm	Choose which alarm relay is being programmed.	1 and/or 2
Status	Set whether or not the alarm is enabled.	Enabled or Disabled
Parameter*	Set the parameter that can activate this alarm.	Humidity, Temperature, Pressure or User Equation
Units*	Set the units for this parameter.	(See Table 4 on page 44 for parameter chosen.)
Type	Set the type of condition that will activate the alarm	SetPoint, Inner Band, Outer Band, Control, Service, PACER
Upper*	The upper side of the alarm band	Enter a number.
Lower*	The lower side of the alarm band	Enter a number.

**These fields are ignored if the alarm is set to Control, Service, or PACER.*

The Upper and Lower limits set the alarm thresholds as described below for each alarm type (see details on page 18):

- SetPoint: alarm activates when parameter exceeds upper limit, and deactivates when parameter is less than lower limit.
- Inner Band: alarm activates when parameter is between upper and lower limits.
- Outer band: alarm activates when parameter is outside upper and lower limits.
- Control: alarm activates when Optica is actively controlling mirror temperature.
- Service: alarm activates when Service indicator is activated.
- PACER: alarm activates when PACER balance is active.

4.5.4 Automatic Cleaning and Balance Function

Note: *For Optica Analyzers with earlier versions of software, see* Appendix F.

Optica Analyzers with version 1.4.1a software have been upgraded to include the ability to program the PACER self-cleaning and rebalancing cycle to run once per day at a preset time. This is referred to as a *Clock Time Interval*. When the unit is programmed in this manner, the front panel PACER softkey is disabled. The *Elapsed Time Interval* initiates the PACER at a preset time after the last PACER was run. The automatic balance cycle will always run upon power up of the analyzers.

To program the *Automatic Cleaning & Balance Function* on the Optica VGA monitor:

1. Make sure the internal clock of the Optica has the correct time.
   a. From the main screen enter **Menu**, then **More**, then **Set Time and Date**.
   b. Highlight the **Date** and **Time** fields and use the Keypad and Softkeys to set the correct time.
2. Set the *Time Programmed Balance Cycle*.
   a. Enter **Menu** and go to the **Automatic Balance Section**.
   b. Open the **Type** pull down menu and choose one of the four selections (see Table 9 below).

Table 9: Automatic Cleaning and Balance Functions

Item	Function	Type
AUTO	Heats the mirror and balances the optics.	Elapsed Time Interval
PACER	First cools the mirror to develop a thick dew/frost layer, then heats and balances the optics.	Elapsed Time Interval
AUTO-D	Heats the mirror and balances the optics.	Clock Time Interval
PACER-D	First cools the mirror to develop a thick dew/frost layer, then heats and balances the optics.	Clock Time Interval

Note: *The **PACER** function will provide more thorough cleaning than the **AUTO** function because it first develops a thick dew/frost layer into which soluble contaminants dissolve. When heated, some of the contaminants are flash-evaporated and the remaining residue accumulates in clusters, resulting in an approximately 85% cleaner surface. The PACER cycle generally takes longer to complete.*

4.5.4 Automatic Cleaning and Balance Function (cont.)

3. Manually clean the mirror as required.

Note: *Manual cleaning provides the most thorough cleaning.*

4. After manual cleaning, initiate the *Automatic Cleaning & Balancing*.

5. To program a specific time of day at which to initiate the *Automatic Cleaning and Balancing:*

a. Highlight either **Auto-D** or **Pacer-D**.

b. In the **Enter Time** dialog box, input the time of day that you would like to initiate the balance cycle in a 24-hour format (for example, 13:30 would be 1:30 PM).

Note: *In this mode the front panel PACER initiation function is disabled. Powering down and restarting the unit will have no effect on the time programmed; however, the PACER will run on startup as is the normal function.*

6. To program an elapsed time to initialize the *Automatic Cleaning and Balancing*:

a. Highlight either **Auto** or **Pacer**.

b. In **Interval** dialog box, input the elapsed time in minutes (for example, 720 would enable the balance cycle to run every 12 hours).

Note: *If the unit is powered down and restarted, or the Automatic Balance is initiated from the font or by using a LAN, the elapsed time will reset.*

Note: ***Show Status*** *should read* "**Enabled**".

7. Select either **Track** or **Hold** for the analog outputs (4-20 mA/0-5 VDC).

Note: *If* ***Track*** *is selected, the actual temperature of the mirror will be transmitted. If* ***Hold*** *is selected, the last prevailing dew point, measured before the balance cycle was initiated, will be transmitted during the time that the balance cycle is running.*

IMPORTANT: *For environments or a gas sample where the mirror accumulates contamination rapidly, the use of an inline filter is recommended. Lower flow rates will also reduce the accumulation of contaminants.*

4.5.5 Data Fields

Table 10: Data Field Options

Item	Function	Available Options
Field	Graph line number and numeric display number to be programmed	1, 2, 3, 4, 5 or 6
Parameter	For the field selected above, choose which parameter will be output.	Humidity, Temperature, Pressure or User Equation
Units	Choose the units for this parameter	See Table 4 on page 44 for the parameter chosen.
GrphMax	Set the parameter value that will produce full-scale on the graph.	(enter a number)
GrphMin	Set the parameter value that will produce zero on the graph.	(Enter a number.)
GrphColor	Set the color for the selected graph line.	Black, Red, Green, Orange, Blue, Violet, Yellow or Brown
Decimals	The number of decimal places for the numeric display	Enter a number (6 maximum).

4.5.6 Buzzer/Sound

Table 11: Buzzer/Sound Option

Item	Function	Available Options
Buzzer/Sound	Sets the length (apparent loudness) of keyclick sounds.	Enter length of keyclick sound in msec (150 msec maximum).

4.5.7 Network Menu

Networking settings including IP Address, Subnet Mask and Default Gateway. Generally, you will obtain these settings from your network administrator. This menu is accessed by selecting the **Network** control button on Menu 1 and pressing **ENTER**.

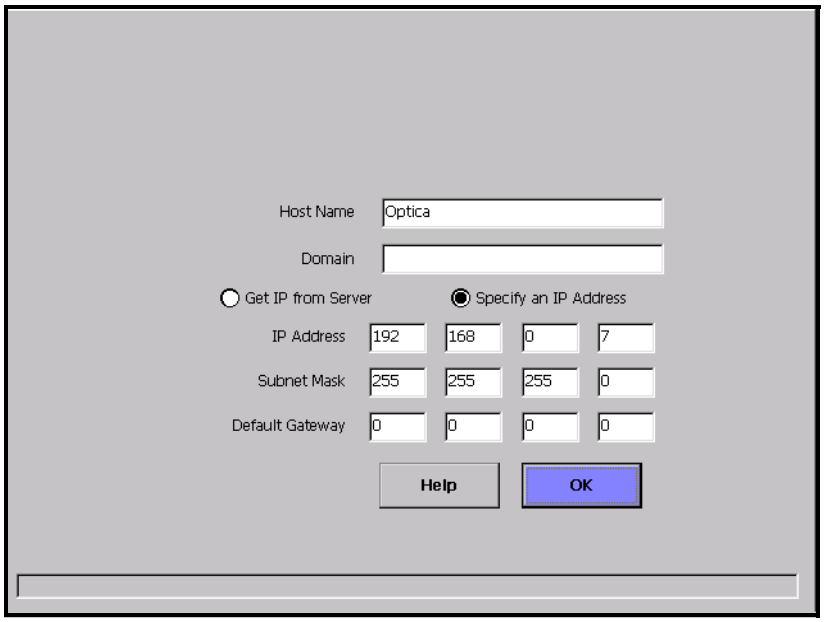


Figure 31: Network Menu

Table 12: Network Settings Options

Item	Function	Available Options
Host Name	Enter the host name for the Optica unit of the LAN.	
Domain	Enter the Domain name for the local network.	
IP Address Type*	Use the left and right arrow keys to select between DHCP and Static IP.	Get the IP from the Server, or Specify an IP Address.
IP Address*	If you choose to specify an IP address, you must enter it here.	Enter four decimal integers between 0 and 255.
Subnet Mask*	If you choose to specify an IP address, you must enter a Subnet Mask.	Enter four decimal integers between 0 and 255.
Default Gateway*	If you choose to specify an IP address, you must enter a Default gateway.	Enter four decimal integers between 0 and 255.
OK button	Save changes and return to the previous screen.	Enter a number (6 maximum).
Help button	Display help for the network screen.	

*You may need to contact your local network administrator for this information.

4.5.8 Datalog

Enter parameters for automatically logging data within the Optica. This menu is accessed by selecting the Data Log control button on Menu 1 and pressing **ENTER**.

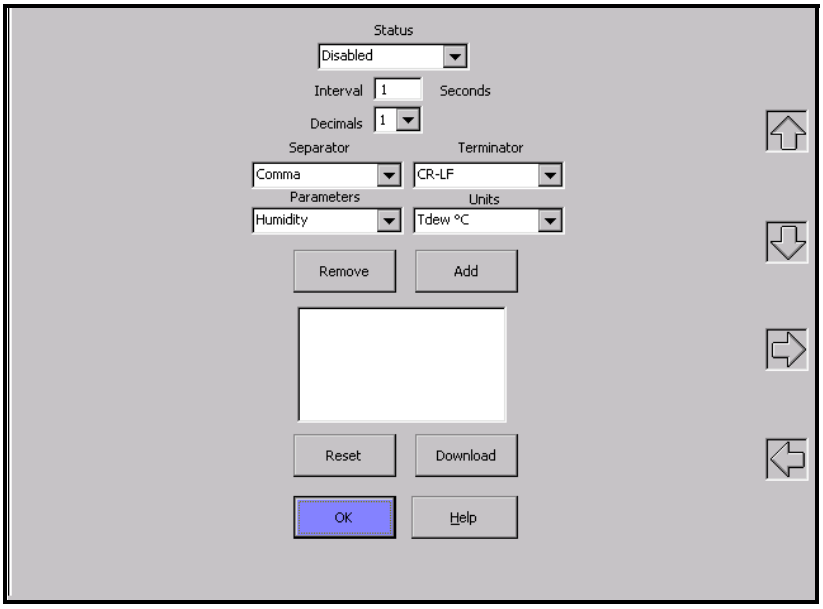


Figure 32: Datalog Menu

The large window below the center of the screen shows a list of parameters chosen for logging.

Table 13: Datalog Options

Item	Function	Available Options
Status*	Enable or disable datalog.	Enabled/Disabled
Interval*	Enter the logging interval in seconds.	Enter a number.
Decimals	Enter the number of decimal places for logged data.	Enter a number (6 maximum).
Separator*	Choose separator to be used between parameters.	Space, Comma, Tab
Terminator*	Choose the terminator(s) for each group of data.	CR, CR-LF, LF
Parameters	Set the parameter to be programmed (below).	Humidity, Temperature, Pressure, or User Equation
Units	Set the units for the selected parameter.	See Table 4 on page 44.
REMOVE	Control button to remove selected item from the list.	Select button and press **ENTER.**
ADD	Control button to add the selected unit to the list.	Select button and press **ENTER.**
RESET	Delete datalog files.	Select button and press **ENTER.**
DOWNLOAD	Control button to display the logged data on the Download screen (see below).	Select button and press **ENTER.**

*Indicated items apply to the entire datalog file.

4.5.8 Datalog (cont.)

Use the **UP** and **DOWN** arrow keys to select items in the center window.

Logged data are stored in a file, named with the file's creation time and date. If logging is in progress at midnight, a new file is automatically started at that time. To view or output the logged data, select the **Download** control button and press **ENTER**. The Optica will display the Download screen, described below.

4.5.8a Download Screen

The Download Screen is accessed by pressing **Download** on the Datalog screen. It contains the following elements:

- a list of any saved files containing logged data (upper left)
- an area for displaying logged data (center)
- **View** button — displays the contents of the selected file name
- **OK** button — return to the previous screen
- **Download** button — send the selected file to the serial port
- **HELP** button — display help system
- Up arrow button — scroll the displayed data upwards
- Down arrow button — scroll the displayed data downwards

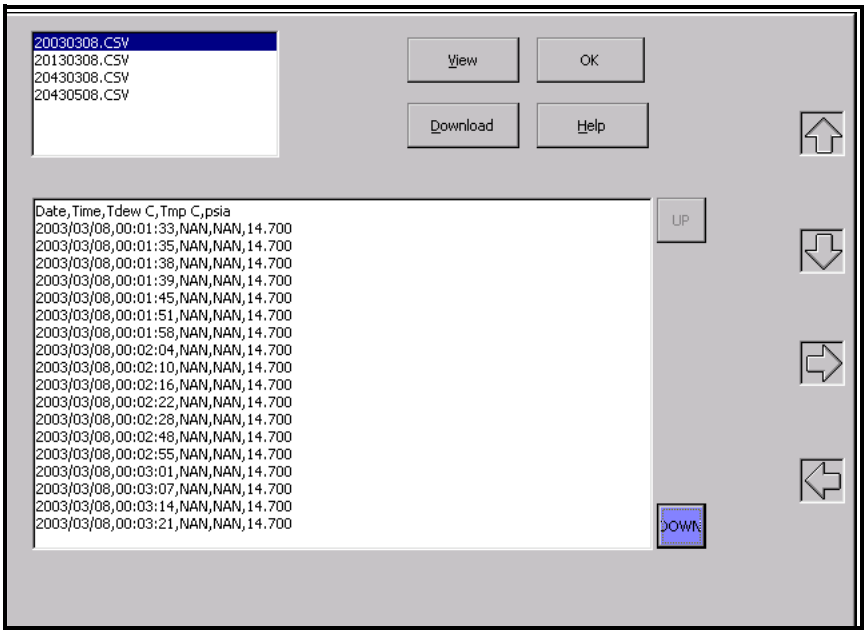


Figure 33: Download Screen

4.6 Menu 2

Menu 2 is shown in Figure 34 below. This menu is accessed by selecting **More** on Menu 1, and pressing **ENTER**.

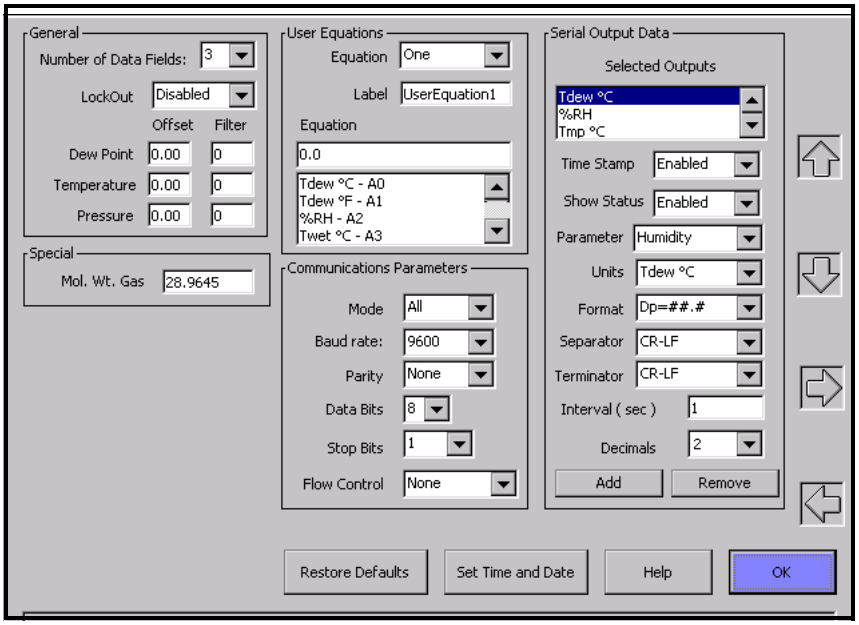


Figure 34: Menu 2

4.6.1 General

Table 14: General Options

Item	Function	Available Options
Number of Data Fields	Set the number of parameters to be displayed.	1, 2, 3, 4, 5, 6
Lockout	Set whether or not Heat, Cool, and PACER functions can be activated by the softkeys on the front panel.	Disabled/Enabled
Dew Point Offset	Enter offset value for Dew Point parameter in °C.	Enter value by which the Dew Point parameter will be offset.
Dew Point Filter	Enter filter value for Dew Point parameter.	Enter number of readings to be averaged to create filtered Dew Point.
Temperature Offset	Enter offset value for Temperature parameter in °C.	Enter the value by which the Temperature parameter will be offset.
Temperature Filter	Enter filter value for Temperature parameter.	Enter number of readings to be averaged to create filtered Temperature.
Pressure Offset	Enter offset value for Pressure parameter in psia.	Enter value by which Pressure parameter will be offset.
Pressure Filter	Enter filter value for Pressure parameter.	Enter number of readings to be averaged to create filtered Pressure.

4.6.2 Special

Table 15: Special Option

Item	Function	Available Options
Mol. Wt. Gas:	The molecular weight of the gas being analyzed (Default value is molecular weight of dry air: 28.9645)	Enter a number.

4.6.3 User Equation

Table 16: User Equation Options

Item	Function	Available Options
Selection	Select which equation to enter or edit.	1, 2, 3
Label:	Enter the test label for the selected equation.	Enter an alphanumeric name.
Equation	Enter the user equation (see *User Equations* on page 44).	Using the keypad, enter the alphanumeric codes for the equation elements, shown in Table 5 on page 45.

4.6.4 Communication Parameters

Table 17: Communication Parameter Options

Item	Function	Available Options
Mode	Set the method for sending data.	**All** (Data is sent continuously.); **Query** (Data is sent when requested by receiving device.) *Query mode is described below.*
Baud	Set the baud rate as required by the receiving device.	300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600
Parity	Set the parity as required by the receiving device.	None, Odd or Even
Data Bits	Set the number of data bits as required by the receiving device.	7 or 8
Stop Bits	Set the number of stop bits as required by the receiving device	1, 1.5 or 2
Flow Control	Set the Flow Control mode as required by the receiving device.	None, X-OFF, RTS/CTS

4.6.4a Query Mode Format:

Command:	**Returns . . .**
$HELP < >	Help string

Note: *The symbol < > indicates a carriage return.*

$GETDATA 0 <item> <item> <item>... <item>	Requested data items
$GETSTATUS 0 < >	Status string

Query mode examples:

$GETDATA 0 0 1 < >	returns the Dew Point °C, Dew Point °F

Note: *The 0 and 1 above, following the "GETDATA 0" command, reference the numeric suffix of the parameter identifier from Table 5 on page 45. For example A0 has units Tdew °C, so the 0 requests Tdew °C.*

$GETSTATUS < >	Returns a string of 1s and 0s corresponding to PACER, Service, Control, Heat, Cool, Alarm 1, Alarm 2

4.6.5 Serial Output Data

Table 18: Serial Output Data Options

Item	Function	Available Options
Selected Outputs	The units of currently selected parameters are shown, along with the number of decimals for each unit.	Units of selected output are displayed. Select one with the UP/DOWN keys to change it or delete it using REMOVE.
Time Stamp*	Output date and time with each data string.	Enabled/Disabled
Show Status*	Output dew point sensor status with each data string (Heat, Cool, Balance, PACER, Service, Alarm 1, Alarm 2).	Enabled/Disabled
Parameter	Select a parameter to configure.	Humidity, Temperature, Pressure or User Equation
Units	Set the units for the selected parameter.	See Table 4 on page 44 for available units.
Format*	Choose output format for the selected parameter.	Dp=##.#, ###.#(Dp), No Label
Separator*	Choose separator to be used between parameters.	Space, Comma, TAB, CR, CR-LF
Terminator*	Choose the terminator(s) for each group of data.	Comma, CR, CR-LF
Interval (sec)*	Enter the output interval in seconds.	Enter a number.
Decimals	Enter the number of decimal places for the selected parameter.	Enter a number (6 maximum).
ADD button	Control button to add the configured parameter to the output list, using the units and number of decimals designated.	Select button and press **ENTER**.
REMOVE button	Control button to remove from the output list the parameter selected at the top of the serial output menu.	Select button and press ENTER

4.6.6 Set Time & Date

The Time and Date menu is accessed by selecting **Set Time and Date** on Menu 2, and pressing **ENTER**.

To set the Optica's internal clock, press TAB to select each field of the date and time, and press the up and down softkeys to set each field. When the settings are correct, tab to the **OK** button and press **ENTER**.

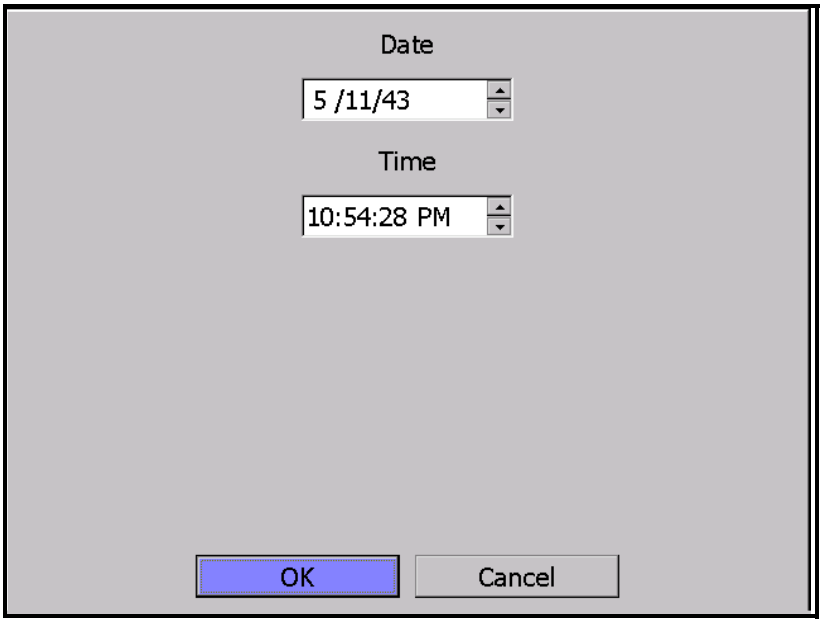


Figure 35: Time and Date

4.6.7 Restore Defaults

To access this choice, select the **Restore Defaults** button on Menu 2, and press **ENTER**.

This screen resets all programmable items to the factory defaults shown in Table 3 on page 37. Press **TAB** to select **Yes**, and press the **ENTER** key.

4.7 Saving Configuration Files

This option allows the user to save a configuration file and then load it onto the system for future use.

Note: *To activate the selected configuration, the system must be reset.*

To save the current configuration file:

1. Select **Configuration** on the Main Screen. A screen similar to the one shown below in Figure 36 appears.
2. Type a file name under **Save Configuration File** and click **SAVE**. The name will appear under **Load Configuration File**.
3. To load or delete an existing configuration file, highlight the name under **Load Configuration File** and click **LOAD** or **DELETE** as desired.
4. To exit the Configuration screen, click **OK**.

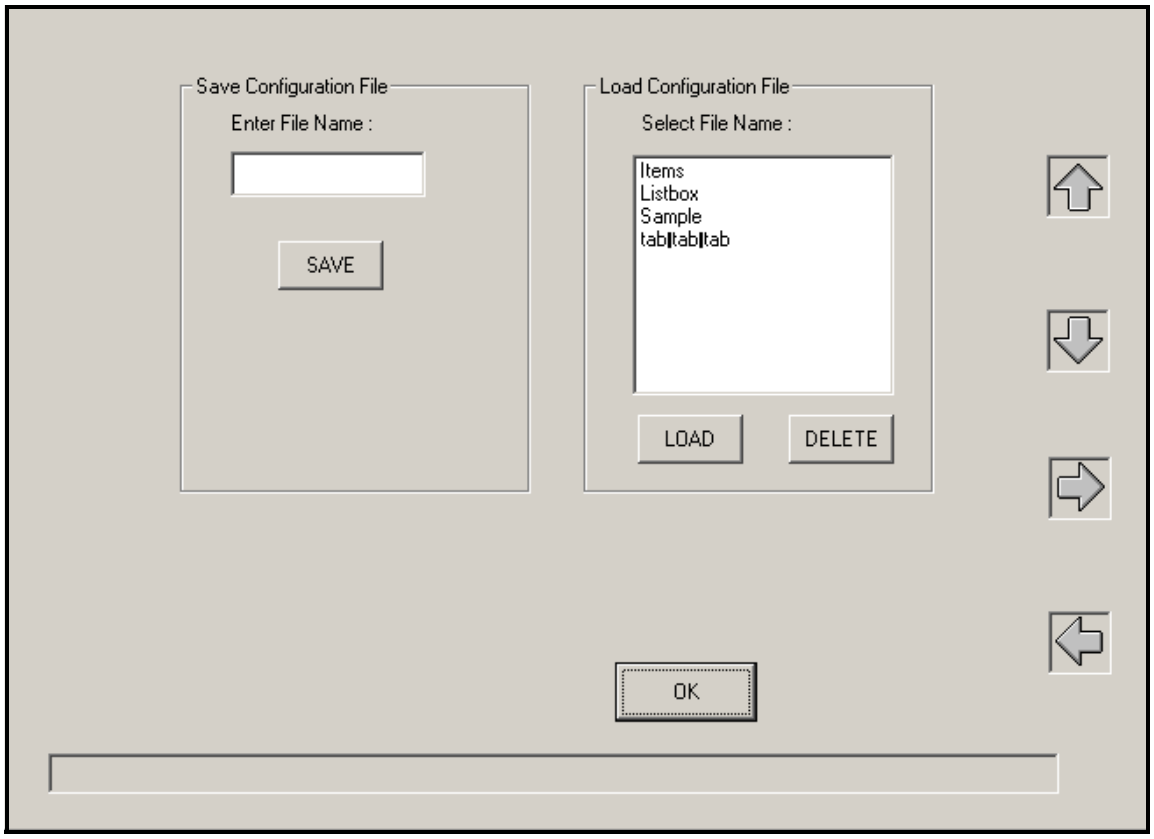


Figure 36: Configuration Screen

Chapter 5. Programming the 4x40 Optica

5.0.1 Introduction

The 4x40 Optica can be easily programmed to choose the data to be displayed, the data to be output on the analog or serial outputs, and the alarm settings. A typical data display is shown in Figure 37 below:

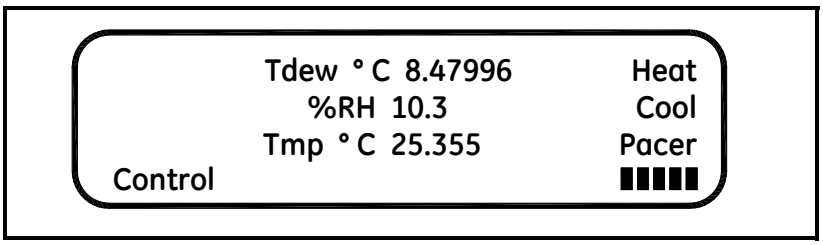


Figure 37: 4x40 Optica Typical Data Display

Table 19 below lists the 4x40 Optica's programmable functions. Each function has a number of settings (listed on the following pages). Values for some settings are selected from a list of choices; others are entered as numeric or alphanumeric data using the keypad.

Table 19: Programming Functions

Function	Settings
About	Displays software version
Analog Outputs	Parameter choice, units and scaling
Communication Parameters	Baud rate, parity, # data bits, etc.
Serial Output Units	Parameter choice, units/data format
Serial Output Setup	Serial data string format
Alarms	Parameter choice and alarm limits
Data Fields	Parameters & units for displayed data
Pressure Input	Units, scaling and default values
Automatic Balance	Frequency and type of balance
Buzzer and Sounds	Keyclick loudness
General Settings	Offsets, filters, lockout
User Equations	Set user defined calculated values.
Set Time and Date	Enter the current time and date.
Special	Set molecular weight of sample gas.
User Default Settings	Restore default settings.
Factory Calibration	For factory use only.

5.1 Programming Technique

The functions of the four softkeys to the right of the display change according to the current state of the unit. These functions, if any, are displayed at the right edge of the screen. While programming, these keys are labelled **UP**, **DOWN**, **LEFT** (displayed as <<<<) and **RIGHT** (displayed as >>>>).

Below is the general method for programming the unit:

1. To access the programming menus, press the **ENTER/MENU** key.
2. Press the **DOWN** key to step through the functions that can be programmed (shown in Table 19 on page 61).
3. For a particular function, press the **RIGHT** key to display the first setting for the function. Press the **DOWN** key to step through its available settings.
4. For a particular setting, press the **RIGHT** key to open the setting for editing.

   If the setting uses a list of specific choices, the **DOWN** key and/or **UP** key are shown. Press them to step through the choices.

   If the setting requires a numeric or alphanumeric entry, use the keypad to enter the data.

Note: *To enter numeric data, just press the appropriate key.*

To enter alphanumeric data, first press **SHIFT** *to access the letters on the keypad, and then press the appropriate key containing the desired letter. Finally, press the up or down arrow softkeys to step through the letters available for that key, both upper and lower case.*

Note that certain settings have numeric values that are restricted to certain choices. For example, the number of stop bits for serial output may be 1, 1.5, or 2, and may have no other values. This entry is selected from a list of choices, not entered as a numeric value.

5. After choosing a value for a setting, press **ENTER** to lock it in.

   Or, you can press the **LEFT** key to cancel the entry (restoring the original value) and return to choose another setting.

To return to the function choice, press the **LEFT** key.

5.1 Programming Technique (cont.)

A typical programming screen (for setting the Analog Outputs) is shown in Figure 38 below.

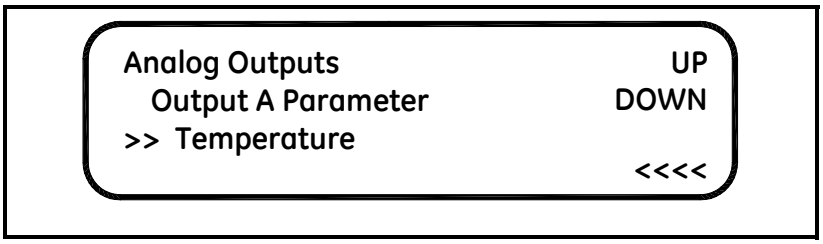


Figure 38: Typical Analog Outputs Programming Screen

An example of programming the Serial Baud Rate is shown in Figure 39 below. Press the **DOWN** and **RIGHT** (>>>>) softkeys as shown to select the parameter to be programmed, choose the value using the **UP** and **DOWN** softkeys, and press **ENTER**.

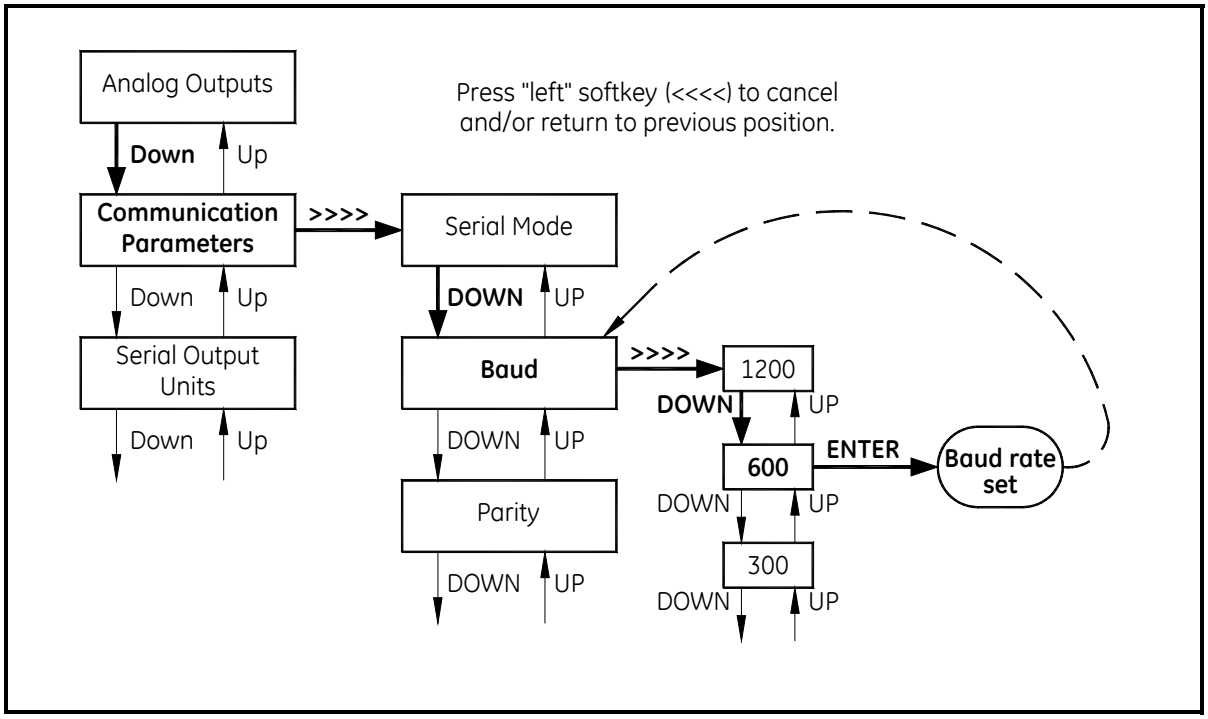


Figure 39: Programming the 4x40 Optica

5.2 Programmable Functions

5.2.1 Analog Outputs

Table 20: Analog Output Options

Setting	Description	Available Options
Output A Parameter	Choose which parameter will be output on analog channel A.	Humidity, Temperature, Pressure or User Equation
Output A Units	Choose the units for scaling this parameter.	See Table 4 on page 44 for the parameter chosen.
Output A Upper	Set the parameter value that will produce full-scale output.	Enter a number.
Output A Lower	Set the parameter value that will produce zero output.	Enter a number.
Output B Parameter	Choose which parameter will be output on analog channel A.	Humidity, Temperature, Pressure or User Equation
Output B Units	Choose the units for scaling this parameter.	See Table 4 on page 44 for the parameter chosen.
Output B Upper	Set the parameter value that will produce full-scale output.	Enter a number.
Output B Lower	Set the parameter value that will produce zero output.	Enter a number.

5.2.2 Communication Parameters

Table 21: Communication Parameter Options

Setting	Description	Available Options
Serial Mode	Set whether data is transmitted continuously or on demand.	All, Query (see Query Mode Format on page 57)
Baud	Set the baud rate to be compatible with the receiving device.	300, 1200, 2400, 4800, 9600, 19200, 38400, 57600
Parity	Set the parity as required by the receiving device.	None, Odd, Even, Mark or Space
Number of Data Bits	Set the number of data bits as required by the receiving device.	7 or 8
Number of Stop Bits	Set the number of stop bits as required by the receiving device.	1, 1.5 or 2
Serial Flow Control	Set the flow control as required by the receiving device.	None, Software, Hardware

5.2.3 Serial Output Units

Table 22: Serial Output Unit Options

Setting	Description	Available Options
Humidity Units*	Set the units for humidity.	See Table 4 on page 44 for the parameter chosen.
Temperature Units*	Set the units for temperature.	See Table 4 on page 44 for the parameter chosen.
Pressure Units*	Set the units for pressure.	See Table 4 on page 44 for the parameter chosen.
User Units*	Set the selected user equation.	Choose from any available User Equation.

*Note: The TAB key selects or deselects the desired output units. If selected, the number of decimals can be set using a keypad entry (0-6).

5.2.4 Serial Output Setup

Table 23: Serial Output Setup Options

Setting	Description	Available Options
Format	Choose the output format for the selected parameter.	For humidity, e.g., Dp=##.#, ###.#(Dp), No Prompt
Field Separator	Choose the separator to be used between parameters.	Space, Comma, Tab, CR, CR-LF
Record Terminator	Choose the terminator(s) for each group of data.	Comma, CR, CR-LF
Interval in seconds	Enter the output interval in seconds (for Serial Mode: All).	Enter a number.
Show Status*	Output dew point sensor status with each data string (Heat, Cool, Balance, PACER, Service, Alarm 1, Alarm2).	Enabled/Disabled
Time Stamp	Output date and time with each data string.	Enabled/Disabled

5.2.5 Alarms

For more information on using the alarms, see Alarm Outputs on page 18.

Table 24: Alarm Options

Setting	Description	Available Options
Alarm #1	Enable or disable Alarm 1.	Enabled/Disabled
Alarm #1 Parameter	Choose the parameter to control Alarm 1.	Humidity, Temperature, Pressure or User Equation
Alarm #1 Units	Set the units for this parameter.	See Table 4 on page 44 for the parameter chosen.
Alarm #1 Type	Set the type of condition that will activate Alarm 1.	Set Point, Inner Band, Outer Band, Control, Service, PACER
Alarm #1 Upper	The upper side of the alarm band.	Enter a number.
Alarm #1 Lower	The lower side of the alarm band.	Enter a number.
Alarm #2	Enable or disable Alarm 2.	Enabled/Disabled
Alarm #2 Parameter	Choose the parameter to control Alarm 2.	Humidity, Temperature, Pressure or User Equation
Alarm #2 Units	Set the units for this parameter.	See Table 4 on page 44 for the parameter chosen.
Alarm #2 Type	Set the type of condition that will activate Alarm 2.	Set Point, Inner Band, Outer Band, Control, Service, PACER
Alarm #2 Upper	The upper side of the alarm band.	Enter a number.
Alarm #2 Lower	The lower side of the alarm band.	Enter a number.

The Upper and Lower limits set the alarm thresholds. Alarm types are listed below (see details on page 18):

- SetPoint: Alarm activates when parameter exceeds upper limit; deactivates when parameter is less than lower limit.
- Inner Band: Alarm activates when parameter is between upper and lower limits.
- Outer band: Alarm activates when parameter is outside upper and lower limits.
- Control: Alarm activates when the Optica is actively controlling mirror temperature.
- Service: Alarm activates when the Service indicator is activated.
- PACER: Alarm activates when the PACER balance is active.

5.2.6 Data Fields

Table 25: Data Field Options

Setting	Description	Available Options
Line 1 Parameter	Choose which parameter will be output on Line 1.	Humidity, Temperature, Pressure or User
Line 1 Units	Set the units for the selected parameter.	See Table 4 on page 44 for the parameter chosen.
Line 1 Decimals	Enter the number of decimal places for displayed data.	Enter a number (0-6).
Line 2 Parameter	Choose which parameter will be output on Line 2.	Humidity, Temperature, Pressure or User
Line 2 Units	Set the units for the selected parameter.	See Table 4 on page 44 for the parameter chosen.
Line 2 Decimals	Enter the number of decimal places for displayed data.	Enter a number (0-6).
Line 3 Parameter	Choose which parameter will be output on Line 3.	Humidity, Temperature, Pressure or User
Line 3 Units	Set the units for the selected parameter.	See Table 4 on page 44 for the parameter chosen.
Line 3 Decimals	Enter the number of decimal places for displayed data.	Enter a number (0-6).

5.2.7 Pressure Input

Table 26: Pressure Input Options

Setting	Description	Available Options
Analog Input #	Choose which pressure input channel is in use, or disable this input.	4-20 mA, 0-5 volt, User Default
Input Units	Choose the units for pressure units.	See Table 4 on page 44 for units.
Input Upper	Set the pressure that corresponds to full-scale input.	Enter a number.
Input Lower	Set the pressure that corresponds to zero volts or 4 mA input.	Enter a number.
Input Default	Pressure value to be used if a measured input is disabled.	Enter a number.
Process Pressure Default	Set whether the process pressure is active (enabled) (see page 32).	Enabled/Disabled
Process Pressure	Enter the process pressure (if this feature is enabled).	Enabled/Disabled

5.2.8 Automatic Cleaning and Balance Function

Note: *For Optica Analyzers with earlier versions of software, see* Appendix F.

Optica Analyzers with version 1.4.1a software have been upgraded to include the ability to program the PACER self-cleaning and rebalancing cycle to run once per day at a preset time. This is referred to as a *Clock Time Interval*. When the unit is programmed in this manner, the front panel PACER softkey is disabled. The *Elapsed Time Interval* initiates the PACER at a preset time after the last PACER was run. The automatic balance cycle will always run upon power up of the analyzers.

To program the *Automatic Cleaning & Balance Function* on the Optica 4X40 monitor:

1. Make sure the internal clock of the Optica has the correct time. From the main screen:

- **a.** Press the **ENTER** key.
- **b.** Press the **DOWN** soft key until **Set Time and Date** is displayed.
- **c.** Press the >>>> soft key.
- **d.** Press the >>>> soft key.
- **e.** Highlight the **Date** and **Time** fields using the tab key. Use the keypad and softkeys to set the correct time.

2. Set the *Time Programmed Balance Cycle*:

- **a.** Press the **ENTER** key to access the Main menu.
- **b.** Press the **DOWN** soft key until **Auto Balance** is shown.
- **c.** Press the >>>> soft key.
- **d.** Press the >>>> to set the interval. Use the soft keys and the key pad.
- **e.** Press the **ENTER** key when done.
- **f.** Press the **DOWN** soft key to select the pacer type.
- **g.** Press the >>>> to enter selection mode.
- **h.** Press the **DOWN** soft key until the desired pacer type is displayed.
- **i.** Press the **ENTER** key to select.
- **j.** Press the **DOWN** soft key to enable the PACER status.
- **k.** Press the **>>>>** soft key to enter selection mode.
- **l.** Press the **UP** or **DOWN** soft key until the *enabled* status is displayed.
- **m.** Press the **ENTER** key to save the selection.
- **n.** Press the <<<< key several times to exit the menu.
- **o.** Under the **Type** pull down menu there will be four selections (see Table 27 below)

5.2.8 Automatic Cleaning and Balance Function (cont.).

Table 27: Automatic Cleaning and Balance Functions

Item	Function	Type
AUTO	Heats the mirror and balances the optics.	Elapsed Time Interval
PACER	First cools the mirror to develop a thick dew/frost layer, then heats and balances the optics.	Elapsed Time Interval
AUTO-D	Heats the mirror and balances the optics.	Clock Time Interval
PACER-D	First cools the mirror to develop a thick dew/frost layer, then heats and balances the optics.	Clock Time Interval

Note: *The **PACER** function will provide more thorough cleaning than the **AUTO** function because it first develops a thick dew/frost layer into which soluble contaminants dissolve. When heated, some of the contaminants are flash evaporated and the remaining residue accumulates in clusters, resulting in the cleaning of much of the mirror's surface. The PACER cycle generally takes longer to complete.*

3. Manually clean the mirror as required.

Note: *Manual cleaning provides the most thorough cleaning.*

4. After manual cleaning, initiate the *Automatic Cleaning & Balancing* cycle. (This can be done by powering the analyzer off then on again, if the front panel softkey is disabled).

5. To program a specific time of day at which to initiate the *Automatic Cleaning and Balancing*:

a. Highlight either **Auto-D** or **Pacer-D**.

b. In the **Set Time** section, input the time of day that you would like to initiate the balance cycle in a 24-hour format (for example, 13:30 will be 1:30 PM).

Note: *In this mode the front panel Pacer initiation function is disabled. Powering down and restarting the unit will have no effect on the time programmed; however, the PACER will run on startup as is the normal function.*

6. To program an elapsed time to initialize the *Automatic Cleaning and Balancing*:

a. Highlight either **AUTO** or **Pacer**.

b. In the set time section, input the elapsed time in minutes. (For example: 720 would enable the balance cycle to run every 12 hours).

Note: *If the unit is powered down and restarted, or the Automatic Balance is initiated from the font or using a LAN, the elapsed time will reset.*

Note: ***Show Status*** *should read "***Enabled***".*

7. Select either **Track** or **Hold** for the analog outputs (4-20mA/0-5VDC).

Note: *If **Track** is selected, the actual temperature of the mirror will be transmitted. If **Hold** is selected, the last prevailing dew point, measured before the balance cycle was initiated, will be transmitted during the time that the balance cycle is running.*

5.2.8 Automatic Cleaning and Balance Function (cont.)

8. Power down and restart the Optica 4x40 display analyzer for the settings to take effect.

IMPORTANT: *For environments or a gas sample where the mirror accumulates contamination rapidly, the use of an inline filter is recommended. Lower flow rates will also reduce the accumulation of contaminants*

5.2.9 Buzzer and Sounds

Table 28: Buzzer and Sounds Option

Setting	Description	Available Options
Buzzer Timing	Sets the length (apparent loudness) of keyclick sounds.	Enter length of keyclick sound in msec (150 msec maximum).

5.2.10 General Settings

Table 29: General Setting Options

Setting	Description	Available Options
Dew Point Offset	Enter the offset value for the Dew Point parameter.	Enter the value by which the Dew Point parameter will be offset.
Dew Point Filter	Enter the filter value for the Dew Point parameter.	Enter the number of readings to be averaged to create filtered Dew Point.
Temperature Offset	Enter the offset value for the Temperature parameter.	Enter the value by which the Temperature parameter will be offset.
Temperature Filter	Enter the filter value for the Temperature parameter.	Enter the number of readings to be averaged to create filtered Temp.
Pressure Offset	Enter the offset value for the Pressure parameter.	Enter the value by which the Pressure parameter will be offset.
Pressure Filter	Enter the filter value for the Pressure parameter.	Enter the number of readings to be averaged to create filtered Pressure.
Lockout	Set whether or not the Heat, Cool, and PACER functions can be activated by the softkeys on the front panel.	OFF / ON

5.2.11 User Equations

See *User Equations* on page 44 for programming information.

Table 30: User Equation Options

Setting	Description	Available Options
Select Equation	Choose an equation to enter or edit.	1, 2, or 3
Edit Label #1*	Enter or edit the label identifying equation 1.	Alphanumeric
Edit Equation #1*	Enter or edit equation 1 using the equation elements shown in Table 5 on page 45.	See Table 5 on page 45.

*The equation number shown is the one chosen in "Select Equation."

5.2.12 Set Time and Date

Table 31: Set Time and Date Options

Setting	Description	Available Options
Set Time	Sets the time.	Enter digits, one at a time, pressing TAB to move to the next digit.
Set Date	Sets the date.	

5.2.13 Special

Table 32: Special Options

Setting	Description	Available Options
Gas Mole Weight	The molecular weight of the gas being analyzed. (The default value is the molecular weight of air: 28.9645)	Enter a number.

5.2.14 User Default Settings

Table 33: User Default Setting Options

Setting	Description	Available Options
Restore Defaults	Restore settings to factory defaults shown in Table 3 on page 37.	NO, YES

5.2.15 Factory Calibrations

Table 34: Factory Calibration Options

Setting	Description	Available Options

For factory use only.

[no content intended for this page]

Chapter 6. Network-Based Programming

6.1 Introduction

The VGA Optica can also be programmed remotely from a computer over a network, using a browser program such as Internet Explorer.

It may be necessary to download and install the Sun Java Runtime Environment (JRE) obtained from the GE distribution CD or Sun's website. If the Sun JRE is not installed on a machine that connects to Optica via Ethernet, a web page will direct the user to Sun's website.

To set up the Optica's networking configuration, see Chapter 4 for programming using the Optica's VGA programming method, and follow the instructions listed in *Network Menu* on page 52.

6.2 Programming Screens

Detailed information on using the Optica Web interface is available via the Help buttons. Programming is very similar to programming of the VGA unit described in Chapter 4, *Programming the VGA Optica*. Of course, you use the mouse to click directly on fields and control buttons instead of selecting items with the TAB key described in Chapter 4.

A typical main data screen is shown below:

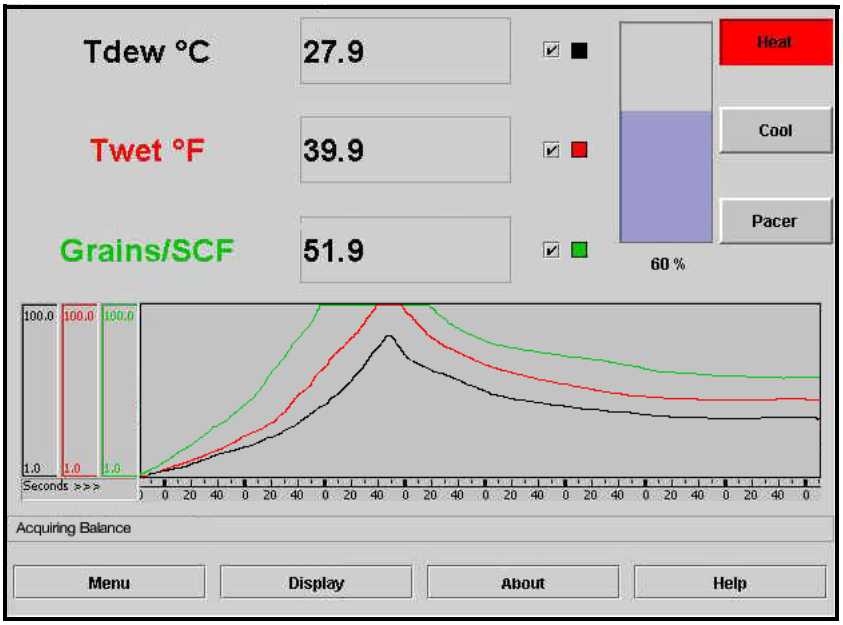


Figure 40: Typical Main Data Screen

6.2 Programming Screens (cont.)

Click on **Menu** to display the Data programming screen:

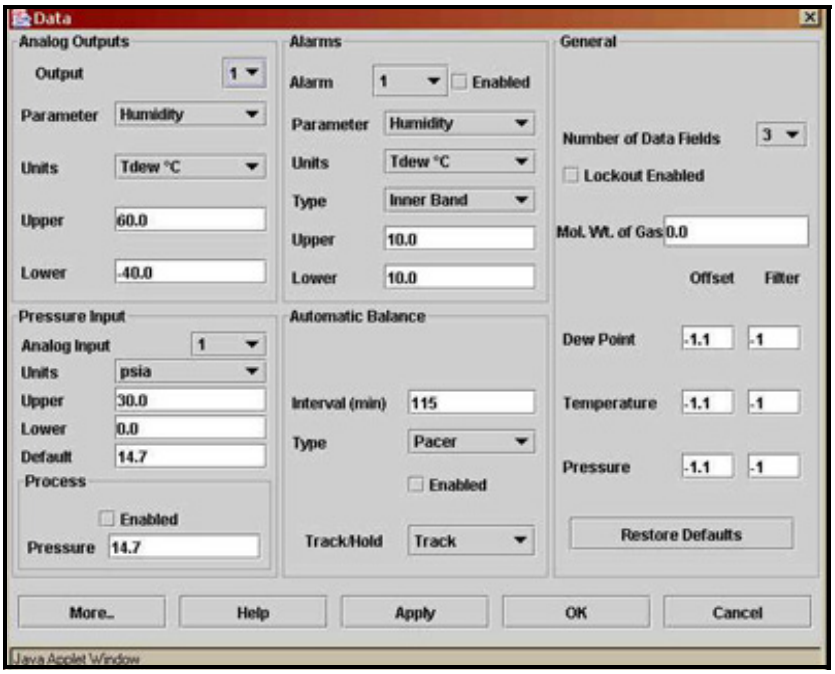


Figure 41: Data Programming Screen

Press **More...** to display the Other Options screen.

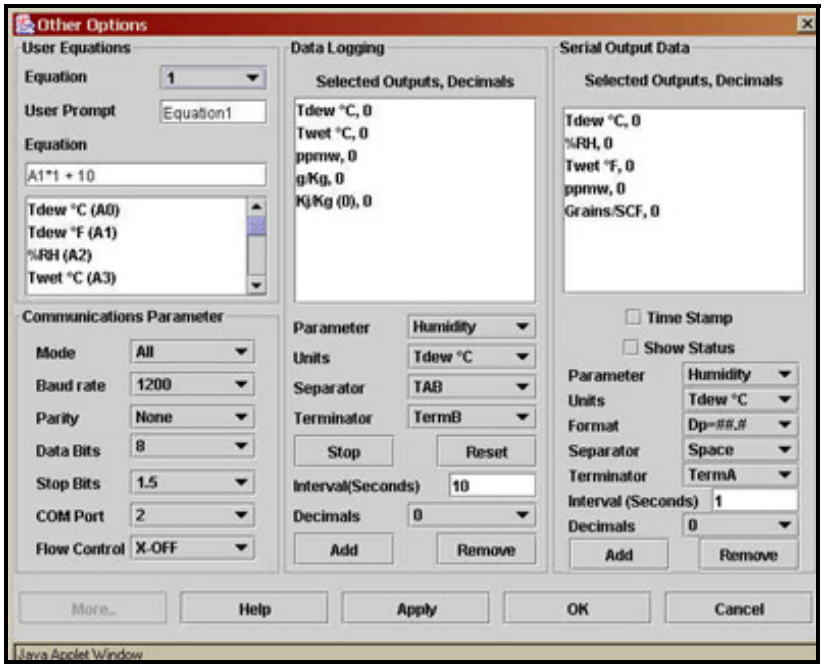


Figure 42: Typical Main Data Screen

6.2 Programming Screens (cont.)

Press **Display** from the main data screen to configure the Main Display screen.

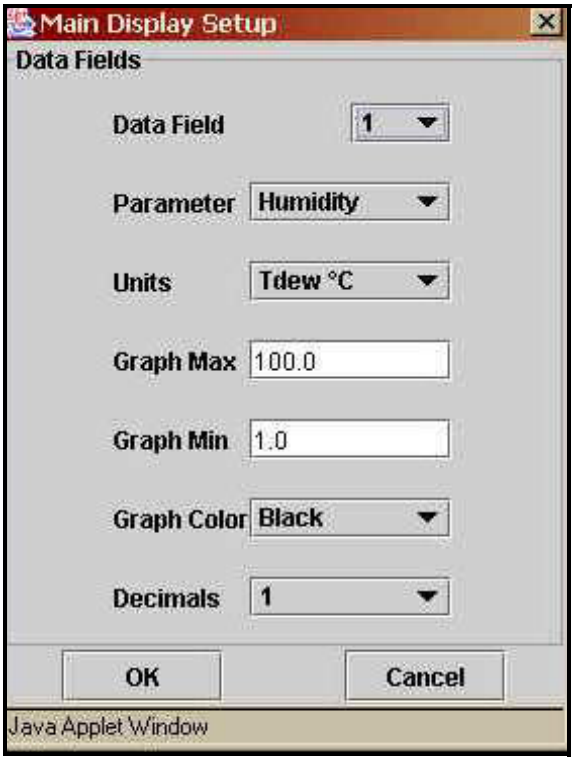


Figure 43: Main Display Screen

[no content intended for this page]

Chapter 7. Maintenance

7.1 Minor Maintenance of Sensor Optics

Periodically inspect and maintain the sensor optics as described in the following chapter. These procedures can be performed at any time, but are only necessary when the **Service** indicator appears on the status display, indicating that service is required.

7.1.1 Cleaning and Balancing the Sensor Mirror

Under normal conditions, the system is self-checking and self-balancing. However, there are occasions when particulate matter and water-soluble contaminants reduce sensor mirror reflectance and system accuracy (see *Contamination* on page 39). Three features of the Optica system allow users to monitor and adjust the mirror:

- The balance indicator (shown in Figure 44 below) provides a graphic display of how much light is received by the mirror's photodetector. It is also an indicator of the dew layer thickness. This indicator increases and decreases in digital steps.
- The bias screw adjusts the light signal received by the reference photodetector and is used as a "coarse adjustment."
- The automatic balance, or PACER cycle (discussed on page 7), electronically fine tunes the optical balance between the IR emitters and reference photodetectors.

In operation, the position of the balance indicator will depend on the level of humidity and the sensor used. As the humidity changes, the chilled mirror system will seek to establish control.

As contaminants deposit on the mirror, the optical balance indicator will increase, as will the dew point readings. The PACER cycle or manual cleaning and balancing (followed by the PACER cycle) will mitigate the contamination.

Note: *If the mirror is severely scratch or pitted, you may not be able to balance it. It may be replaced in the field, as discussed on page 82. For industrial applications, GE recommends the solid platinum mirror.*

Figure 44: Balance and Status Indicator on Optica Display

7.1.2 Procedure for Cleaning and Balancing the Sensor Mirror

When necessary, use the procedure below to clean and balance the sensor mirror. To clean the mirror, you will require the MSK Kit, which includes essential supplies:

- Cotton swabs
- Screwdriver or hex driver for some sensors
- Cleaning solution

1. From the Optica analyzer, press the soft-key next to the HEAT button, or, from the Optica Java applet running on your PC, move your mouse pointer over the HEAT button and click. The button will turn red, as shown in Figure 7-1 on the previous page.
2. Allow the dew point temperature (mirror temperature) to attain the maximum value.
3. To clean the mirror:
   a. Remove the cap or open the cover of the chilled mirror sensor.
   b. Put one drop of cleaning solution on a cotton swab.
   c. Gently rub the cotton swab on the mirror in a circular motion (spiral outwards) to clean the mirror.
   d. Use a dry swab to dry and buff the mirror. The mirror should be bright and shiny.
   e. Discard the used swabs.

IMPORTANT: *If the contamination is severe, then solvents such as alcohol, acetone or hexane may be used, followed by a rinse of the cleaning solution then distilled water. Be sure to dry and buff the mirror with a dry swab.*

4. Observe the balance indicator. It should have only one bar segment illuminated. Figure 45 below shows the possible variations for the indicator while the mirror is heated.

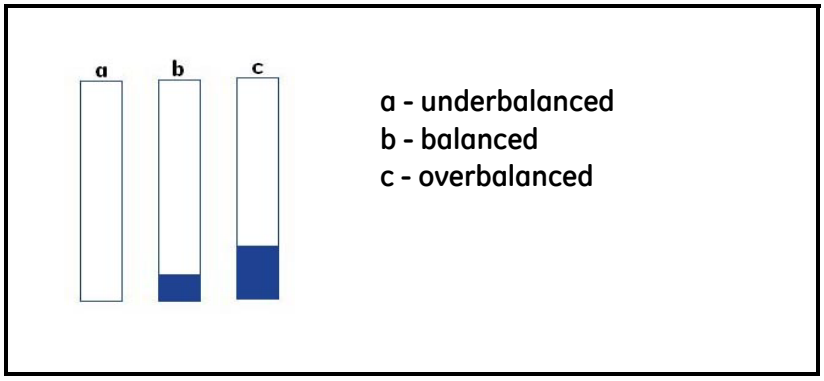


Figure 45: Coarse Adjust Balance Indicator While Mirror is Heated

7.1.2 Procedure for Cleaning and Balancing the Sensor Mirror (cont.)

5. If more than one bar segment or no bars are illuminated, use the screw or hex driver to adjust the optical bias screw (shown in Figure 46 below) on the sensor until only one bar is illuminated. You are performing a coarse balance adjustment.

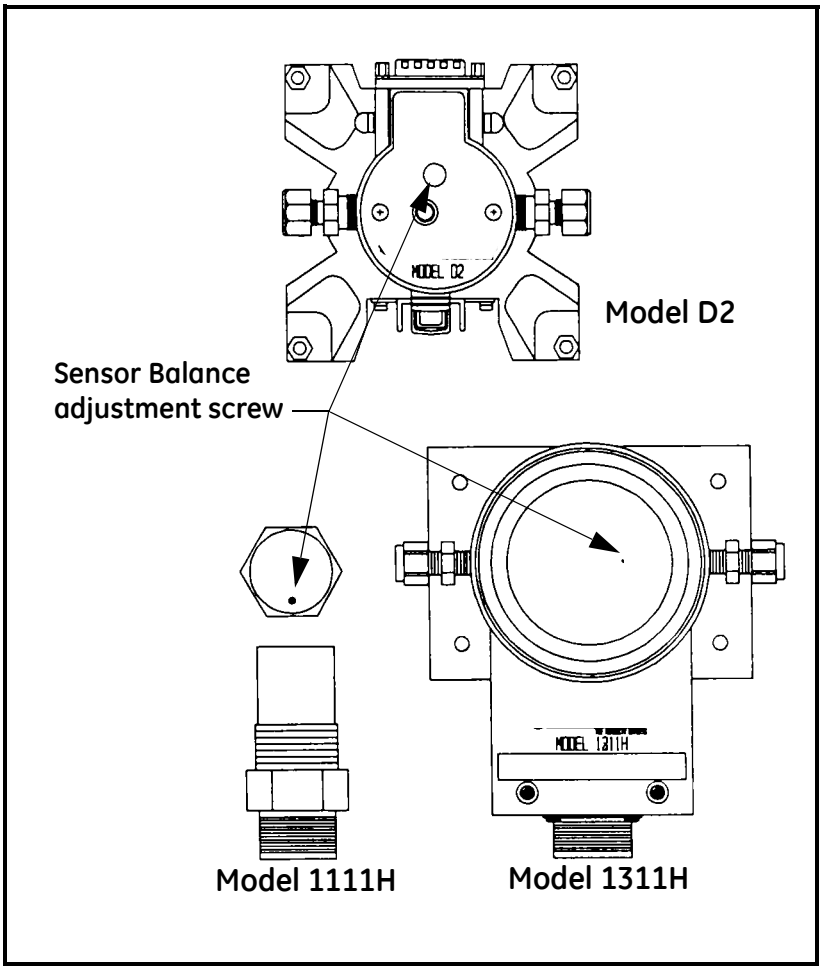


Figure 46: Balance Adjustment Screw Locations

IMPORTANT: *This adjustment is made while the cap or cover is on the 1111H & D2 sensors. For the 1211H, SIM-12H, 1311-DR & 1311-XR, the adjustment is made with the cap removed. In these cases the adjustment should not be made in sunlight, bright incandescent or infrared light. It might be useful to shade the sensor cavity with your hand or place a coin over the sensor cavity.*

6. Once balanced, replace the sensor cap and make sure the balance indicator does not change.

7.1.2 Procedure for Cleaning and Balancing the Sensor Mirror (cont.)

7. From the Optica analyzer press the soft-key next to the PACER button, or, from Optica Java applet running on your PC, move your mouse pointer over the PACER button and click. The button will turn magenta, as shown in Figure 47 below.

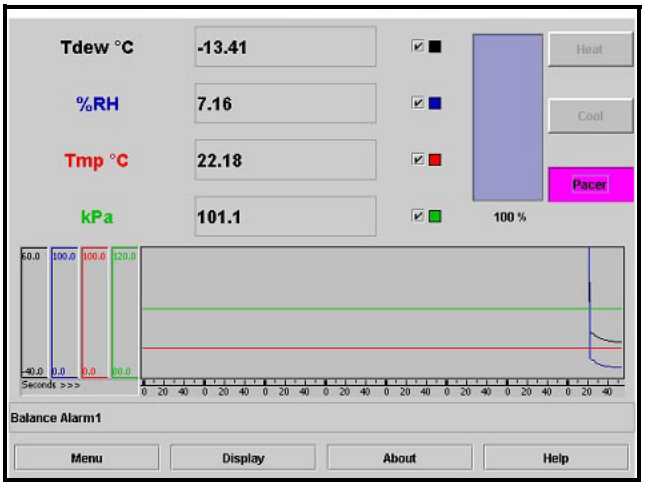
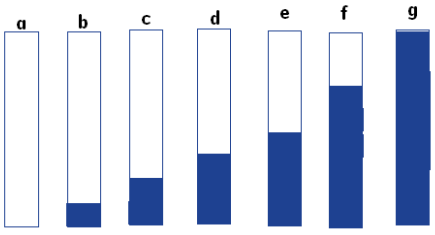


Figure 47: Display with PACER Button Activated

If the "Automatic Balance" is set for "Pacer," the system will first cool, then heat. If the unit is set for "Auto," it will only heat. The system will then automatically fine tune the optical balance. The word **Balance** will appear in the lower left of the display, followed by the phrase **Balance_acquiring.**

The unit will then cool to the dew point and the balance indicator will increase when dew or frost condenses on the mirror. The dew point reading might overshoot, then it will stabilize (assuming the sensor is exposed to constant humidity). Figure 48 below shows the possible stages of the balance indicator.



a - underbalanced: clean & rebalance
b - mirror in dry state
c - control at low humidity
d - control at low-medium humidity
e - control at medium-high humidity
f - control at high humidity
g - over balanced or contaminated: clean & rebalance

Figure 48: Stages of Balance Indicator

7.1.2 Procedure for Cleaning and Balancing the Sensor Mirror (cont.)

When a stable dew or frost layer is attained, you will see the word **Control** in the lower left. The Optica is now reading the correct dew/frost point and a stable dew or frost layer has been established. When the Optica is exposed to typical room humidity, this process takes 5-6 minutes. For very dry conditions, the unit may not display **Control** for several hours; however, the PACER indicator will go out. The sensor must first accumulate a dew or frost layer on the mirror before it can display **Control.**

8. If you see the word **Service** displayed in the lower left, repeat steps 1-7.

7.2 Field Replacement of Sensor Mirrors

One advantage of using a GE Measurement & Control chilled mirror dew point sensor is that the mirror is user-replaceable. The sensor does not have to be returned to the factory for replacement of the reflective surface, unless that is desired.

A mirror may require replacement for any of the following reasons:

The mirror is constructed of silver/rhodium plated copper. Copper provides excellent thermal conductivity to the platinum thermometer. However, some gas constituents, such as sulfur dioxide (SO2) may react with the copper and eventually pit the surface or form a copper sulfate coating.

The reflective surface may be gradually abraded by sharp dirt particles in the gas being measured.

The mirror surface may be accidentally scratched or gouged during use or cleaning.

If the sensor mirror has reacted with a corrosive material in the gas sample, such as an acid or sulfur compound, it should be replaced with a solid platinum mirror to remove any possibility of copper corrosion.

In extreme cases, a solid platinum mirror can make possible a successful application of chilled mirror technology. For example, measurements in tobacco factories and malting houses have drastically improved after this change, since both locations have sample gas constituents that attack copper.

7.2.1 Replacing the Sensor Mirror

Required equipment: torque driver, set to 20-30 inch-ounces of torque. GE type TW-1 is recommended.

The kit supplied by the factory contains the replacement mirror, a container of white thermal compound for proper heat transfer, and (in some models) a mylar washer that is to be placed under the mirror.

1. Deactivate the sensor cooler, using one of the following actions:
   - Turn the sensor power off, or
   - Place the sensor switch to heat, or
   - Disconnect the sensor cable
2. Turn off the sample gas. Make sure the sensor cavity is depressurized before continuing with the next step.
3. Open the sensor by removing the sensor cover.
4. Unscrew and discard the old mirror, using a 3/16-inch (0.187) hex socket.
5. Use a toothpick or similar tool to place a small amount of thermal compound in the hole supporting the mirror.

CAUTION! Do not apply thermal compound to the mirror stem.
Do not use an amount large enough to leak out when the mirror is tightened.
Do not allow any compound to get on the mirror surface, as it is very difficult to remove completely.

6. Carefully screw in the new mirror and tighten to the proper torque as specified for the particular sensor.
7. Carefully clean the mirror surface, using a cotton swab and the GE cleaning solution supplied with the maintenance kit. Distilled alcohol or diluted alcohol is also acceptable.
8. Replace the cover and return the sensor to normal operation. Under some circumstances, a new mirror may operate in a somewhat unstable manner for the first hour or two.

7.3 Test and Calibration

The procedures in this section effectively test and/or calibrate the following aspects of the Optica:

- Startup and power supply voltage
- Normal sensor operation
- Front panel display
- Digital and analog outputs.

The unit has been completely tested and calibrated at the factory, and is ready to plug in and operate. As shipped, it meets all of our published specifications.

When ordered as a complete hygrometer system with a chilled mirror sensor and cable, it is verified at a number of points against a dew point system that has been certified by the U.S. National Institute of Standards and Technology (NIST). A Certificate of Compliance is supplied with the unit to indicate traceability.

7.4 Troubleshooting

7.4.1 The Display Doesn't Light Up

1. Check the **POWER** switch on the rear panel. Make sure it's **ON**.
2. Check the line cord. Make sure both ends are plugged in and that it is plugged into a proper source of AC voltage.
3. Check the power supply. Make sure it is connected and has the proper output voltage.
4. Check the fuse. Make sure the proper fuse size is installed. Make sure the fuse is not open.

7.4.2 "Service" Appears on the STATUS Display Line

The text "**Service**" displayed on the **STATUS** line means service is required. The most frequent problem requiring service is that the mirror surface is contaminated and should be cleaned.

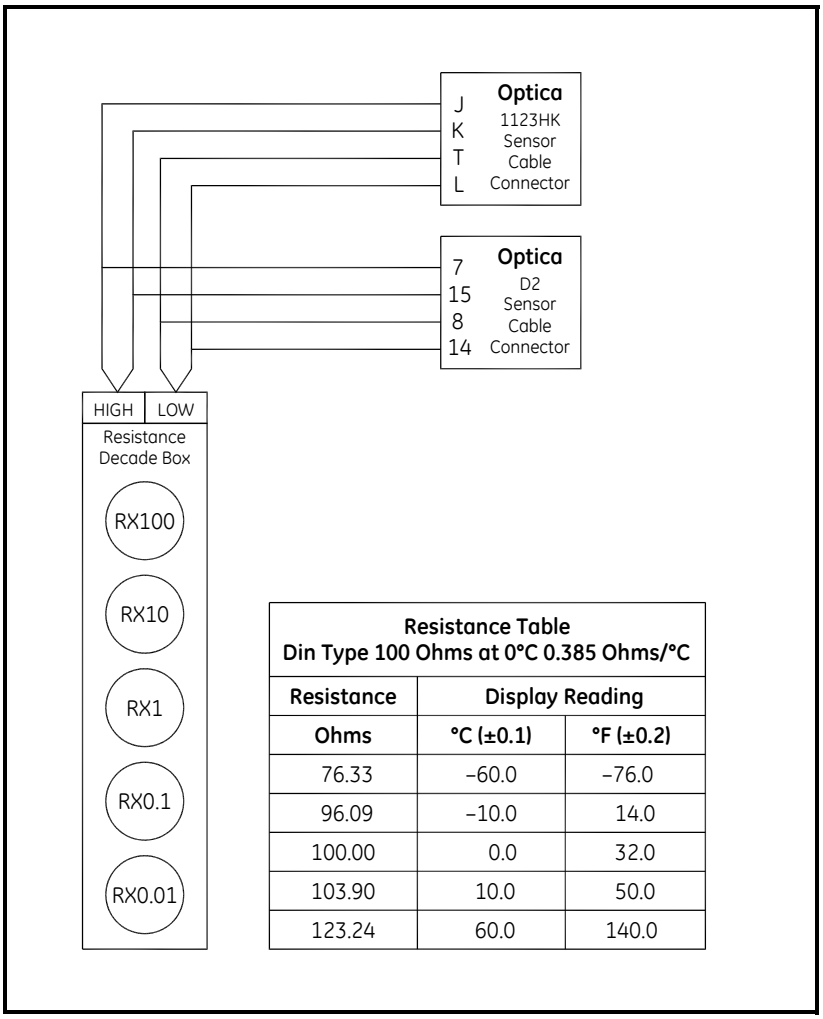
Clean and balance the sensor mirror (refer to *Minor Maintenance of Sensor Optics* on page 77). Next, run the instrument through a PACER cycle. If, at the end of the cycle, the **Service** status appears again, repeat the cleaning and balancing procedure, or contact the factory.

7.4.3 Incorrect Dew Point Display

If the dew/frost point reads incorrectly, first check the standard preventive maintenance items:

Clean and balance the sensor mirror (refer to page 77).

An alternative method for checking the accuracy of the unit's electronics is to use a precision resistance decade box in place of the platinum thermometer. Wire the decade box to the unit's sensor connector as shown in Figure 49 below, and verify that the resistance settings shown in the table produce the temperatures shown.



Resistance Table Din Type 100 Ohms at 0°C 0.385 Ohms/°C		
Resistance	**Display Reading**	
Ohms	**°C (±0.1)**	**°F (±0.2)**
76.33	–60.0	–76.0
96.09	–10.0	14.0
100.00	0.0	32.0
103.90	10.0	50.0
123.24	60.0	140.0

Figure 49: Using a Resistance Decade Box

7.4.4 "Balance" Remains on the Status Line

When the word **Balance** remains displayed on the front panel for more than 15 minutes, the instrument has not recovered from a PACER cycle.

Check that the sensor and sensor cable are connected. If necessary, connect them, and the unit will complete the PACER cycle after a short time (5 to 15 minutes).

The sensor optical bridge may be out of balance (refer to page 77).

7.4.5 No Analog Output

If there is no analog output, but the digital display indicates correctly, check the analog output scaling. For the VGA unit, see *Analog Outputs* on page 46. For the 4x40 unit, see *Function 1 — Analog Outputs* on page 64.

7.4.6 No Serial Output

Check the serial port programming for proper settings. For the VGA unit, see instructions on page 58. For the 4x40 unit, see instructions on page 65.

Appendix A. Specifications

A.1 Performance

A.1.1 Accuracy [complete system at 25°C (77°F)]

A.1.1a Dew/Frost Point:

±0.2°C (±0.36°F)

A.1.1b Temperature (optional):

±0.15°C (±0.27°F)

A.1.1c Pressure (optional):

A.1.1d ±0.5% of full scale

A.1.1e Relative Humidity (optional):

Governed by accuracy of dew point and temperature sensors

A.1.1f Other Humidity Parameters: (optional)

Governed by accuracy of dew point, temperature and pressure sensors

Sensitivity. > 0.05°C (0.09°F)

Repeatability. ± 0.05°C (±0.09°F)

Hysteresis. Negligible

A.1.2 Measurement Ranges

A.1.2a Chilled Mirror Sensors: (available)

1111H, 1211H, D-2, SIM-12H, 1311DR, 1311XR

A.1.2b Range:

–80°C to +85°C (–112°F to +185°F)
dew/frost point, depending on sensor used

A.1.2c Temperature Sensor: (optional)

T-100E: –100°C to +100°C (–148°F to +212°F)

A.1.2d Pressure Sensors (optional):

PT-30A: 0 – 30 psia (0 to 2 bar)
PT-300A: 0 to 300 psia (0 to 21 bar)
User supplied 4-20mA or 0-5 volt signal

Recommended Sample Flow. 0.5 to 5.0 scfh (0.25 to 2.5 L/min)

A.1.3 Response Time

A.1.3a Dew/Frost Point Cooling Rate:

1.5°C (2.7° F)/sec [typical, above 0°C (32°F)]

A.1.3b Temperature Response: (optional)

< 7 sec for step change within +25°C to +70°C (+77°F to +158°F)

A.1.3c Pressure Response (optional):

1 sec to 90% of steady state (10% to 90% change)

Update Time. 1 sec

A.2 Functionality

Outputs. 4–20mA DC, 500 Ohm maximum load, 0–5 VDC, 5mA maximum

Digital Output. Serial port

A.2.1 Alarms

A.2.1a Relay (optional):

Form C (SPDT) 5A, 250 VAC (resistive load)

Displays. 640 X 480 pixel color LCD or 4-line X 40-char LCD

Power. 95 to 265 VAC (+/-10%), 50-60 Hz, 200 W

A.2.2 Operating Ranges

A.2.2a Dew Point Sensors

Ambient Temperature:

–15°C to +80°C (+5°F to + 176°F), depending on sensor

Pressure:

0 to 300 psig (0 to 22 bar), depending on sensor)

A.2.2b Electronics

Ambient Temperature:

0°C to +50°C (+32°F to +122°F)

Relative Humidity:

85% maximum

A.3 Physical (bench mount)

A.3.1 Dimensions

13.5"W x 6.5"H x 13"D (353 x 165 x 330 mm)

A.3.2 Weight

8 lbs (3.6 kg)

A.3.3 Shipping Weight

15 lbs (7 kg)

A.3.4 Environmental

General purpose bench-, panel-, or rack-mount

A.4 Physical (wall mount)

A.4.1 Dimensions

3.5"W x 16.5"H x 6.5"D (343 x 419 x 165 mm)

A.4.2 Weight

10 lbs (4.5 kg)

A.4.3 Shipping Weight

15 lbs (7 kg)

A.4.4 Environmental

Surface-mount, industrial environment (NEMA-4)

A.5 Optional Accessories

19" rack mount adapter

A.5.1 T-100E

Temperature sensor

A.5.2 PT-30A

Pressure transducer (0 – 30 psia)

A.5.3 PT-300A

Pressure transducer (0 – 300 psia)

A.6 European Compliance

Complies with EMC Directive 2004/108/EC and 2006/95/EC Low Voltage Directive (Installation Category II, Pollution Degree II)

Note: *Product has reduced limits for Radiated immunity between 88 and 108 MHz and conducted immunity between 11 and 32 MHz.*

Specifications subject to change without notice.

Appendix B. Humidity Equations and Conversion Chart

B.1 Introduction

The following symbols appear in the equations below:

***e* =**

Vapor Pressure, millibars

***e_i* =**

Vapor Pressure with respect to ice, millibars

***e_w* =**

Vapor Pressure with respect to water, millibars

***e_{is}* =**

Saturation vapor pressure, ice, millibars

***e_{ws}* =**

Saturation vapor pressure, water, millibars

***P* =**

Total Pressure, millibars

***T* =**

Temperature, °C

***T_a* =**

Ambient temperature, °C

***T_d* =**

Dew point temperature, °C

***T_f* =**

Frost point temperature, °C

B.2 Vapor Pressure

Saturation vapor pressure with respect to water is a function of temperature only and is given by the following:

$$E_{WS} = 6.1121 EXP\left[\frac{17.502T}{240.97 + T}\right]$$

Saturation vapor pressure with respect to ice requires a minor adjustment of the constants as given by the following:

$$E_{IS} = 6.1115 EXP\left[\frac{22.452T}{272.55 + T}\right]$$

In addition to yielding saturation vapor pressure as a function of ambient temperature, the above equations also yield ambient vapor pressure as a function of dew/frost point.

The total pressure of a gas mixture is equal to the sum of the partial pressure each gas would exert, were it to occupy the same total volume, according to Dalton's law.

B.3 Humidity

Relative Humidity is defined as the ratio of the water vapor pressure (e) to the saturation vapor pressure (e_S) at the prevailing ambient or dry bulb temperature (Ta):

$$\%RH = 100\left(\frac{E}{E_S}\right) = 100\left[\frac{E_W(T_D)}{E_{WS}(T_A)}\right]$$

Absolute humidity is expressed as water vapor density: water vapor mass per unit volume of dry air, according to the following:

$$\frac{G}{M^3} = \frac{216.7E(T_D)}{T + 273.16}$$

Water vapor content expressed as parts per million by volume is given by the following:

$$PPM_V = 10^6 \frac{E(T_D)}{P - E(T_D)}$$

Expressing water vapor content as parts per million by weight (or mixing ratio) requires multiplication of the above by the ratio of the molecular weight of water to that of air as given by the following:

$$PPM_W = 0.622 \times 10^6 \frac{E}{P - E}$$

See Figure 50 on page 93 for a graphical humidity conversion chart.

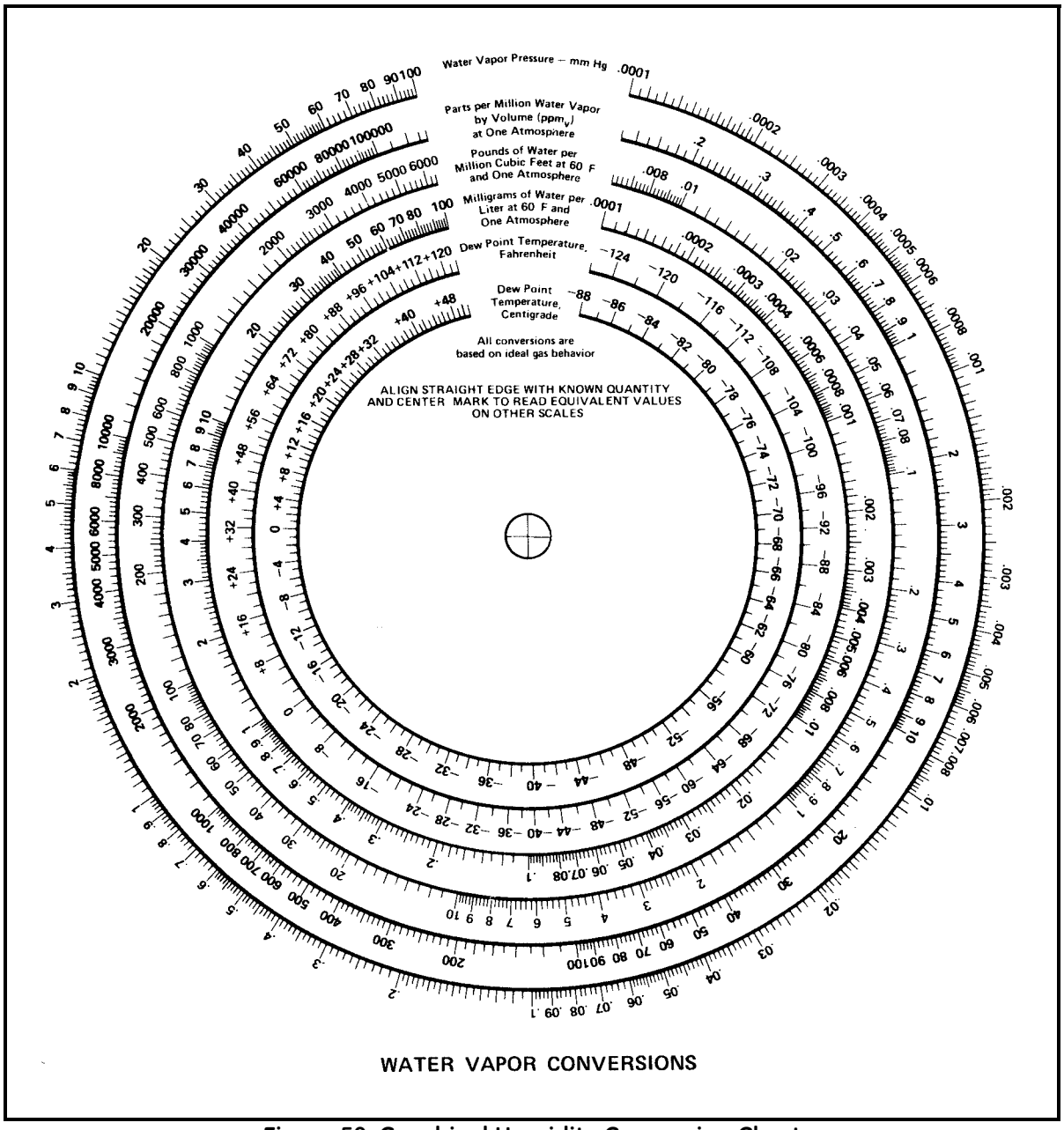

Water Vapor Pressure — mm Hg
Parts per Million Water Vapor by Volume (ppm$_v$) at One Atmosphere
Pounds of Water per Million Cubic Feet at 60 F and One Atmosphere
Milligrams of Water per Liter at 60 F and One Atmosphere
Dew Point Temperature, Fahrenheit
Dew Point Temperature, Centigrade
All conversions are based on ideal gas behavior
ALIGN STRAIGHT EDGE WITH KNOWN QUANTITY AND CENTER MARK TO READ EQUIVALENT VALUES ON OTHER SCALES
WATER VAPOR CONVERSIONS

Figure 50: Graphical Humidity Conversion Chart

[no content intended for this page]

Appendix C. Configuring the Serial Interface

C.1 Wiring to a Personal Computer

The Optica is configured as Data Terminal Equipment (DTE). The following pins are used on the Serial interface:

- 2 - Transmitted data (**TXD**)
- 3 - Received data (**RXD**)
- 5 - Signal ground (**GND**)

To send the output of the Optica to a personal computer, use the cable arrangement shown in Figure 51 below.

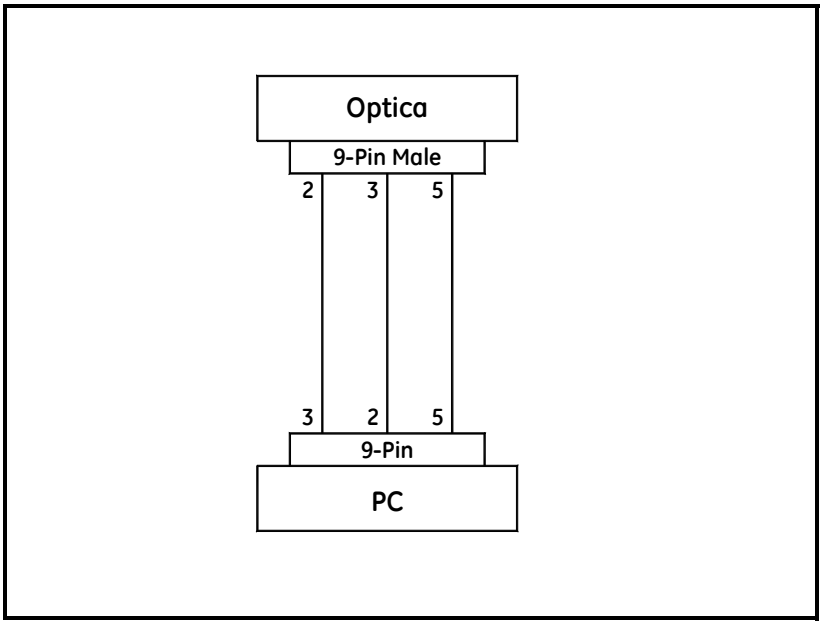


Figure 51: Wiring Diagram - Optica to Personal Computer

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Appendix D. Chilled Mirror Sensors

D.1 Introduction

GE offers a choice of six, fully interchangeable, chilled mirror sensors which differ primarily in their depression (cooling) capability. Depression capacity determines the minimum dew point that can be measured. All of the sensors feature low-noise, infrared optics, a field-replaceable mirror, and can be located up to 300 ft (91 m) from the electronics. Other advanced features—depending on the sensor selected—include heating capability, four- or five-stage thermoelectric cooling, air and water cooling for additional depression, and modular, field-replaceable optics and cooling assemblies

Many of these features were pioneered by GE Measurement & Control, and are available only on GE products.

A chilled mirror sensor is generally selected so that its depression capability will allow it to measure the lowest dew/frost point anticipated for the application.

D.2 Depression

A Peltier device is a solid-state heat pump. It has one surface thermally bonded to the body (base) of a dew point sensor and the other surface bonded to the mirror block. When current is supplied to the Peltier device, heat is “pumped” from the mirror block to the sensor body where it is dissipated. With full cooling current, the mirror block will eventually cool to its minimum temperature. The difference between the temperatures of the mirror block and the sensor body when the mirror block is at this minimum temperature is defined as the depression capability of the sensor.

Depression capability is a function of how many “stages” the Peltier device has stacked in series. Thus, a two-stage sensor typically has 60°C to 65°C (108°F to 117°F) of depression capability, and can measure lower dew/frost points than a one-stage sensor which has 45°C (81°F) of depression capability. Depression is normally specified at 25°C (77°F) ambient temperature. For liquid-cooled sensors, it is specified at the coolant temperature. As ambient temperature (and, therefore, sensor body temperature) is decreased, depression capability also decreases, due to the drop-off in efficiency of the thermoelectric cooler.

Therefore, there are limitations to using liquid-cooled sensors to increase low-end measurement range. At nominal dew/frost points, approximately one third of the additional cooling is lost due to cooler inefficiency, and does not result in additional measurement range. At low dew/frost points, as much as one half may be lost. As ambient temperature is increased, depression capability increases, resulting in a wider measurement range.

D.3 Measurement Range

The measurement range of a chilled mirror sensor is defined as the temperature range over which a stable dew or frost layer can be maintained on the mirror. Note that in order to acquire a dew or frost layer on the mirror, the depression capability of a sensor must extend below its measurement range. The minimum required differential between depression range and measurement range is 5°C (9°F) at nominal dew/frost points, and increases to 10°C to 12°C (18°F to 22°F) at very low frost points.

Measurement range is normally specified at 25°C (77°F) ambient temperature in air at atmospheric pressure. For sensor body temperatures other than 25°C (77°F), measurement range can be estimated by first estimating depression capability, and then decreasing this range according to the minimum required differential. For most gases other than air, the effect on measurement range is negligible. However, gases such as hydrogen or helium, which are more thermally conductive than air, will result in a decrease of several degrees in the measurement range. Measurement range will decrease as gas pressure is increased, because the increased density (and, therefore, increased thermal conductivity) of the gas results in an increased heat load. For air or nitrogen, each 50 psi (3 bar) increase above atmospheric pressure will result in a loss of approximately 2°C (4°F) of depression capability. Conversely, operating under vacuum may result in a small increase.

Other factors influencing sensor selection include temperature and pressure ratings, and whether anticipated dew points will be higher than ambient temperature.

D.4 Comparing Optica Models

Table 35: Chilled Mirror Sensor Comparison Chart

	Model 1111H	Model D-2	Model 1211H	Model SIM-12H	Model 1311DR	Model 1311XR
System Performance						
Standard Accuracy*	0.2°C	0.2°C	0.2°C	0.2°C	0.2°C	0.15°C
Optical Accuracy*	0.15°C	0.15°C	0.15°C	0.15°C	0.15°C	
Cooling Stages	1	2	2	2	4	5
Depression (at 25°C (77°F), 1 atm, in air)	45°C	65°C	65°C	65°C	95°C, air; 105°C with 15°C coulant	112°C with 15°C coulant
Typical Measurement Range (at given ambient, 1 atm)	@25°C ambient	@ 25°C ambient	@ 25°C ambient	@ 85°C ambient	@ 25°C ambient	@ 25°C ambient
Dew/Frost Point	–15° to +25°C	–35° to +25°C	–35° to +25°C	–10° to +85°C	–60° to +25°C, air –70°C to +25°C, liquid	–80° to +25°C
RH (equivalent)	6% to 100%	1.5% to 100%	1.5% to 100%	1% to 100%	0.03% to 100%, air 0.007% to 100%, liq.	0.0003% to 100%
Functional Characteristics:						
Power	From Optica	From Optica	From Optica	115/ 230VAC 75 watts	115/230VAC 300 watts	115/230VAC 700 watts
Ambient Temperature Range	–15° to +80°C	–25° to +85°C	–15° to +100°C	–15° to +50°C	0° to +35°C	0° to +35°C
Pressure Range (psig)	–3 to +200	–14.7 to +150	0 to +300	–3 to +50	0 to +300	0 to +100
Auxiliary Cooling	No	No	No	No	Standard: air or liquid	Standard: liquid
Sensor Cavity Material	Epoxy-coated Aluminum	Stainless Steel	Stainless Steel	Anodized Aluminum	Stainless Steel	Stainless Steel

*Complete system at 25°C (77°F)

[no content intended for this page]

Appendix E. Glossary

Depression Capability

The temperature difference by which the chilled mirror can be lowered from the ambient temperature.

Network

A Local Area computer Network (LAN) or Wide Area Network (WAN) such as the Internet. The Optica can be operated or programmed remotely over a network.

PACER

GE Sensing patented Programmable Automatic Contaminant Error Reduction system, which consolidates soluble contaminants to reduce their effect on system accuracy (see *The PACER Cycle* on page 7).

Parameter

A measured quantity available for display by the unit, such as Dew Point in °C, Humidity in Grams/Kilograms, or Pressure in Bar.

Process Pressure

The gas pressure of the system under test. In some applications, humidity of this gas may be measured at a lower pressure.

Scaling

The process of selecting the maximum and minimum output values of a chosen parameter.

SHIFT

Pressing the **SHIFT** key enters Shift Key mode, reversing the direction of the cursor motion when pressing **TAB**, and accessing the non-numeric characters on the keypad.

Softkeys

The four keys to the right of the display. The functions of these keys change depending on the context, and the current function is displayed to the left of each key.

VGA

Video Graphics Array Generic description of a 640 by 480 pixel display; used to identify the large-screen Optica.

4x40

Four lines by 40 characters per line; used to identify the small-screen Optica.

[no content intended for this page]

Appendix F. Automatic Balance (for earlier software versions)

F.1 Programming Automatic Balance for a VGA Optica

Note: *For Optica Analyzers with software version 1.4.1a or later, see* Automatic Cleaning and Balance Function *on page 49.*

Table 36: Automatic Balancing Options

Item	Function	Available Options
Interval	Set how often the automatic balance takes place.	Enter the interval in minutes (60 minutes minimum).
Type	Set the type of balance (see *Sensor Balancing* on page 38).	Auto, PACER
Status	Set whether the balance will take place.	Enabled, Disabled
Track/Hold	Set whether the display, analog outputs, and alarms will track the sensor condition during a cleaning cycle, or hold the last process reading. (Serial outputs always hold the process reading).	Track, Hold

F.2 Programming Automatic Balance for a 4x40 Optica

Note: *For Optica Analyzers with software version 1.4.1a or later, see* Automatic Cleaning and Balance Function *on page 68.*

Table 37: Automatic Balancing Options

Setting	Description	Available Options
Interval in Minutes	Set how often the balance takes place.	Enter the interval in minutes (60 minutes minimum).
Type	Set the type of balance (see *Sensor Balancing* on page 38).	Auto, PACER
Enable	Set whether the balance will take place.	Enabled, Disabled
Analog Output Tracking	Set whether display, analog outputs and alarms will track the sensor condition during a cleaning cycle, or hold the last process reading. (Serial output will always track the process reading.)	Track, Hold

[no content intended for this page]

Appendix G. Communicating with the OPTICA Using Ethernet

G.1 Direct Communication

The networking configuration for an **OPTICA VGA** model can be done using the front panel. The networking configuration for a 4x40 with Ethernet capability can be configured using the RS-232 port and the following commands:

Note: *<> means carriage return.*

$SetIPAddress <IPADDRESS><> (i.e 127 0 0 0)\r\n

Example: `$SetIpAddress 127 0 0 0 0 <>`

$SetSubnetMask <SubNetMask> (i.e 255 255 255 0)\r\n

Example: `$SetSubnetMask  255 255 255 0 <>`

$SetDefaultGateway <Gateway> (i.e 0 0 0 0)\r\n

$SetHostName <HostName><> (i.e Optica)\r\n

$SetIPSource <STATIC><> (STATIC IP)\r\n

$SetIPSource <DHCP><> (DHCP IP)\r\n

$GetNetworkSettings<> Displays the network settings\r\n

$SaveNetworkSettings<>
(Write Network settings to the registry)\r\n

$DeleteNetworkSettings<>
(Deletes registry entries - removes .FDF & .CRC File)\r\n

$SaveAllSettings<>
(Write all settings to non-volatile memory)\r\n

G.2 Computer Communication

The Optica communicates over port 28005. The general format for accessing the Optica is:

<IP address>:28005/Command

The command set of the Optica is broken into two categories: Those used to *set* parameters and those used to *retrieve* parameters from the Optica. Commands that are used to retrieve information from the Optica are preceded with the prefix **Get**, and those that are used to set parameters at the Optica are preceded with the prefix **Set**. Only the commands that enable the user to retrieve information from the Optica are detailed in this document. The examples below assume that a web browser is being used.

G.2.1 Determining the Available Commands

The available commands can be determined by entering the line below in the address line of the browser. This command returns a list of API commands supported by the Optica.

http://3.112.160.36:28005/OpticaAPI.xml

<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
<OpticaAPIInfo>

<help>---- **OpticaAPI.xml?FunctionName+channel** ----</help>
<OpticaAPI>**GetAlarmData**</OpticaAPI>
<OpticaAPI>**GetAlarmTypes**</OpticaAPI>
<OpticaAPI>**GetAllGraphingData**</OpticaAPI>
<OpticaAPI>**GetAllLabels**</OpticaAPI>
<OpticaAPI>**GetAnalogOutData**</OpticaAPI>
<OpticaAPI>**GetAutoBalanceTypes**</OpticaAPI>
<OpticaAPI>**GetChannelInfo**</OpticaAPI>
<OpticaAPI>**GetCurrentData**</OpticaAPI>
<OpticaAPI>**GetDataFields**</OpticaAPI>
<OpticaAPI>**GetDataLogSettings**</OpticaAPI>
<OpticaAPI>**GetHTPLabels**</OpticaAPI>
<OpticaAPI>**GetHTPParam**</OpticaAPI>
<OpticaAPI>**GetPressureData**</OpticaAPI>
<OpticaAPI>**GetOpticaInfo**</OpticaAPI>
<OpticaAPI>**GetSerialCommData**</OpticaAPI>
<OpticaAPI>**GetSerialData**</OpticaAPI>
<OpticaAPI>**GetSupportedBaudRate**</OpticaAPI>
<OpticaAPI>**GetSupportedDataBits**</OpticaAPI>
<OpticaAPI>**GetSupportedSerialDataFormat**</OpticaAPI>
<OpticaAPI>**GetSupportedDataLogDataFormat**</OpticaAPI>
<OpticaAPI>**GetUserDefinedEquations**</OpticaAPI>
<OpticaAPI>**UpdateGraphingData**</OpticaAPI>
<help>---- **Set functions are not accessible with GET** ----</help>
<OpticaAPI>**SetAlarmData**</OpticaAPI>
<OpticaAPI>**SetAlarmTypes**</OpticaAPI>
<OpticaAPI>**SetAnalogOutData**</OpticaAPI>

G.2.1 Determining the Available Commands

<OpticaAPI>**SetAutoBalanceTypes**</OpticaAPI>
<OpticaAPI>**SetChannelInfo**</OpticaAPI>
<OpticaAPI>**SetCoolState**</OpticaAPI>
<OpticaAPI>**SetCurrentData**</OpticaAPI>
<OpticaAPI>**SetDataFields**</OpticaAPI>
<OpticaAPI>**SetDataLogSettings**</OpticaAPI>
<OpticaAPI>**SetHeatState**</OpticaAPI>
<OpticaAPI>**SetHTPLabels**</OpticaAPI>
<OpticaAPI>**SetHTPParam**</OpticaAPI>
<OpticaAPI>**SetPacerOn**</OpticaAPI>
<OpticaAPI>**SetPressureData**</OpticaAPI>
<OpticaAPI>**SetOpticaInfo**</OpticaAPI>
<OpticaAPI>**SetSerialCommData**</OpticaAPI>
<OpticaAPI>**SetSerialData**</OpticaAPI>
<OpticaAPI>**SetSupportedBaudRate**</OpticaAPI>
<OpticaAPI>**SetSupportedDataBits**</OpticaAPI>
<OpticaAPI>**SetSupportedSerialDataFormat**</OpticaAPI>
<OpticaAPI>**SetUserDefinedEquations**</OpticaAPI>
</OpticaAPIInfo>

G.2.2 Retrieving the Alarm Settings

Command:
http://3.112.160.36:28005/OpticaAPI.xml?GetAlarmData+0
Function Name: GetAlarmData
Channel: 0

Response:
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
<OpticaAPIReturn Function="**GetAlarmData**">
<channel>**0**</channel>

<AlarmType>**2**</AlarmType>
<Enabled>**true**</Enabled>
<UnitOffset>**2**</UnitOffset>
<type>**2**</type>
<LowerLimit>**30.000000**</LowerLimit>
<UpperLimit>**60.000000**</UpperLimit>

<AlarmType>**2**</AlarmType>
<Enabled>**true**</Enabled>
<UnitOffset>**17**</UnitOffset>
<type>**17**</type>
<LowerLimit>**18.000000**</LowerLimit>
<UpperLimit>**26.000000**</UpperLimit>
<retval>**GEIAPI_SUCCESS**</retval>
</OpticaAPIReturn

G.2.2 Retrieving the Alarm Settings (cont.)

The Optica supports two alarm set points: The above response shows the settings for alarm 1 and alarm 2 in that order. (Note that the index is referenced from 0 , not 1). Alarm 1 parameters are described below.

Alarm 1 Settings:

Alarm type = **2**
(SetPoint, InnerBand, Outerband, Control, Service, Pacer)
2 here indicates Outerband

Enabled = **True** (Alarm 1 is enabled.)

Unit Offset = **2** (% RH)
See the Optica manual or use the GetHTPLabels for the list of available units and the order.

Type = **2** (ignore this value)

LowerLimit = **18.000000** (the Lower limit is 18 %RH)

UpperLimit = **26.000000** (The Upper limit is 26 %RH)

G.2.3 Retrieving the Alarm Types

This command enables the user to retrieve different alarm types that are supported by the Optica, and the order in which they are referenced.

Command:
http://3.112.160.36:28005/OpticaAPI.xml?GetAlarmTypes
Function Name: GetAlarmTypes
Channel: 0

Response:

```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
 <OpticaAPIReturn Function="GetAlarmTypes">
  <NumAlarmTypes>6</NumAlarmTypes>
  <AlarmType>SetPoint</AlarmType>
  <AlarmType>Inner Band</AlarmType>
  <AlarmType>Outer Band</AlarmType>
  <AlarmType>Control</AlarmType>
  <AlarmType>Service</AlarmType>
  <AlarmType>Pacer</AlarmType>
  <retval>GEIAPI_SUCCESS</retval>
</OpticaAPIReturn>
```

This Response indicates that 6 alarm types are supported. They are listed in order with the reference being 0.

G.2.4 Retrieving Supported Units

This command enables the user to retrieve different units that are supported by the Optica and the order in which they are referenced.

Command: http://3.112.160.36:28005/OpticaAPI.xml?GetAllLabels
Function Name: GetAlarmTypes
Channel: 0

Response:

```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
 <OpticaAPIReturn Function="GetAllLabels">
  <channel>0</channel>
  <sLabels>Tdew °C</sLabels>
  <sLabels>Tdew °F</sLabels>
  <sLabels>%RH</sLabels>
  <sLabels>Twet °C</sLabels>
  <sLabels>Twet °F</sLabels>
  <sLabels>ppmv</sLabels>
  <sLabels>ppmw</sLabels>
  <sLabels>Grains/lb</sLabels>
  <sLabels>Grains/SCF</sLabels>
  <sLabels>g/kg</sLabels>
  <sLabels>g/m3</sLabels>
  <sLabels>lb/Mft3</sLabels>
  <sLabels>Kj/Kg (0)</sLabels>
  <sLabels>Kj/Kg (32)</sLabels>
  <sLabels>Btu/lb (0)</sLabels>
  <sLabels>Btu/lb (32)</sLabels>
  <sLabels>pw(mbar)</sLabels>
  <sLabels>Tmp °C</sLabels>
  <sLabels>Tmp °F</sLabels>
  <sLabels>Tmp °K</sLabels>
  <sLabels>Tmp °R</sLabels>
  <sLabels>psia</sLabels>
  <sLabels>mbar</sLabels>
  <sLabels>bar</sLabels>
  <sLabels>Pa</sLabels>
  <sLabels>kPa</sLabels>
  <sLabels>mmHg</sLabels>
  <sLabels>inHg</sLabels>
  <sLabels>KgCm2</sLabels>
  <sLabels>DyneCm2</sLabels>
  <sLabels />
  <sLabels>UserEquation2</sLabels>
  <sLabels>UserEquation3</sLabels>
  <retval>GEIAPI_SUCCESS</retval>
</OpticaAPIReturn>
```

G.2.5 Retrieving Labels and Functions

This command enables the user to retrieve different units that are supported by the Optica, and the order in which they are referenced. It also indicates which labels are humidity labels, temperature labels and pressure labels.

Command:

http://3.112.160.36:28005/OpticaAPI.xml?GetHTPLabels+0

Function Name: GetHTPLables
Channel: 0

Response:

```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
<OpticaAPIReturn Function="GetHTPLabels">
<channel>0</channel>
 <iHumidityLabels>17</iHumidityLabels>
 <sHumidityLabels>Tdew °C</sHumidityLabels>
 <sHumidityLabels>Tdew °F</sHumidityLabels>
 <sHumidityLabels>%RH</sHumidityLabels>
 <sHumidityLabels>Twet °C</sHumidityLabels>
 <sHumidityLabels>Twet °F</sHumidityLabels>
 <sHumidityLabels>ppmv</sHumidityLabels>
 <sHumidityLabels>ppmw</sHumidityLabels>
 <sHumidityLabels>Grains/lb</sHumidityLabels>
 <sHumidityLabels>Grains/SCF</sHumidityLabels>
 <sHumidityLabels>g/kg</sHumidityLabels>
 <sHumidityLabels>g/m3</sHumidityLabels>
 <sHumidityLabels>lb/Mft3</sHumidityLabels>
 <sHumidityLabels>kj/kg (0)</sHumidityLabels>
 <sHumidityLabels>kj/kg (32)</sHumidityLabels>
 <sHumidityLabels>Btu/lb (0)</sHumidityLabels>
 <sHumidityLabels>Btu/lb (32)</sHumidityLabels>
 <sHumidityLabels>pw(mbar)</sHumidityLabels>
 <iTemperatureLabels>4</iTemperatureLabels>
 <sTemperatureLabels>Tmp °C</sTemperatureLabels>
 <sTemperatureLabels>Tmp °F</sTemperatureLabels>
 <sTemperatureLabels>Tmp °K</sTemperatureLabels>
 <sTemperatureLabels>Tmp °R</sTemperatureLabels>
 <iPressureLabels>9</iPressureLabels>
 <sPressureLabels>psia</sPressureLabels>
 <sPressureLabels>mbar</sPressureLabels>
 <sPressureLabels>bar</sPressureLabels>
 <sPressureLabels>Pa</sPressureLabels>
 <sPressureLabels>kPa</sPressureLabels>
 <sPressureLabels>mmHg</sPressureLabels>
 <sPressureLabels>inHg</sPressureLabels>
 <sPressureLabels>kg/cm2</sPressureLabels>
 <sPressureLabels>DyneCm2</sPressureLabels>
 <iUserLabels>3</iUserLabels>
 <sUserLabels />
```

G.2.5 Retrieving Labels and Functions (cont.)

<sUserLabels>**UserEquation2**</sUserLabels>
<sUserLabels>**UserEquation3**</sUserLabels>
<iLabels>**33**</iLabels>
<sLabels>**Tdew °C**</sLabels>
<sLabels>**Tdew °F**</sLabels>
<sLabels>**%RH**</sLabels>
<sLabels>**Twet °C**</sLabels>
<sLabels>**Twet °F**</sLabels>
<sLabels>**ppmv**</sLabels>
<sLabels>**ppmw**</sLabels>
<sLabels>**Grains/lb**</sLabels>
<sLabels>**Grains/SCF**</sLabels>
<sLabels>**g/kg**</sLabels>
<sLabels>**g/m3**</sLabels>
<sLabels>**lb/Mft3**</sLabels>
<sLabels>**Kj/Kg (0)**</sLabels>
<sLabels>**Kj/Kg (32)**</sLabels>
<sLabels>**Btu/lb (0)**</sLabels>
<sLabels>**Btu/lb (32)**</sLabels>
<sLabels>**pw(mbar)**</sLabels>
<sLabels>**Tmp °C**</sLabels>
<sLabels>**Tmp °F**</sLabels>
<sLabels>**Tmp °K**</sLabels>
<sLabels>**Tmp °R**</sLabels>
<sLabels>**psia**</sLabels>
<sLabels>**mbar**</sLabels>
<sLabels>**bar**</sLabels>
<sLabels>**Pa**</sLabels>
<sLabels>**kPa**</sLabels>
<sLabels>**mmHg**</sLabels>
<sLabels>**inHg**</sLabels>
<sLabels>**KgCm2**</sLabels>
<sLabels>**DyneCm2**</sLabels>
<sLabels />
<sLabels>**UserEquation2**</sLabels>
<sLabels>**UserEquation3**</sLabels>
<HumidityUnitsBaseIndex>**0**</HumidityUnitsBaseIndex>
<TemperatureUnitsBaseIndex>**17**</TemperatureUnitsBaseIndex>
<PressureUnitsBaseIndex>**21**</PressureUnitsBaseIndex>
<UserUnitsBaseIndex>**30**</UserUnitsBaseIndex>
<retval>**GEIAPI_SUCCESS**</retval>
</OpticaAPIReturn>

This response indicates how many humidity labels (iHumidityLabels), temperature labels (iTemperatureLabels), pressure labels (iPressureLabels) and UserLabels there are. The iLabels value indicates how many labels there are all together (33).

G.2.6 Retrieving Analog Output Information

This command enables the user to retrieve settings for the two analog outputs.

Command:
http://3.112.160.36:28005/OpticaAPI.xml?GetAnalogOutData+0
Function Name: GetAnalogOutData
Channel: 0

Response:

```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
 <OpticaAPIReturn Function="GetAnalogOutData">
  <channel>0</channel>
  <UnitOffset>0</UnitOffset>
  <LowerLimit>-40.000000</LowerLimit>
  <UpperLimit>60.000000</UpperLimit>
  <UnitOffset>17</UnitOffset>
  <LowerLimit>0.000000</LowerLimit>
  <UpperLimit>100.000000</UpperLimit>
  <retval>GEIAPI_SUCCESS</retval>
</OpticaAPIReturn>
```

UnitOffset is an index to the list of labels. In this case **0** refers to **Tdew °C**

G.2.7 Retrieving the Measured and Calculated Values

This command enables the user to retrieve measured and calculated values for all supported units. The status information is also returned.

Command:
http://3.112.160.36:28005/OpticaAPI.xml?GetCurrentData+0
Function Name: GetCurrentData
Channel: 0

Response:

```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
 <OpticaAPIReturn Function="GetCurrentData">
  <channel>0</channel>
  <channelName />
```

Note: *iNumber is the number of data values returned.*

This number is the same as "iLabels" of GetHTPLabels and those labels coincide with these values.

```
  <iNumber>33</iNumber>
  <fAllData>-4.892536</fAllData>
  <fAllData>23.193436</fAllData>
  <fAllData>16.158667</fAllData>
  <fAllData>9.333572</fAllData>
```

G.2.7 Retrieving the Measured and Calculated Values (cont.)


```
 <fAllData>48.800430</fAllData>
 <fAllData>4014.087158</fAllData>
 <fAllData>2496.681885</fAllData>
 <fAllData>17.476774</fAllData>
 <fAllData>6.832514</fAllData>
 <fAllData>2.496682</fAllData>
 <fAllData>2.985780</fAllData>
 <fAllData>186.449982</fAllData>
 <fAllData>43.695812</fAllData>
 <fAllData>26.523333</fAllData>
 <fAllData>19.541956</fAllData>
 <fAllData>11.861956</fAllData>
 <fAllData>4.055074</fAllData>
 <fAllData>21.146547</fAllData>
 <fAllData>70.100189</fAllData>
 <fAllData>294.306549</fAllData>
 <fAllData>529.753784</fAllData>
 <fAllData>14.710732</fAllData>
 <fAllData>1014.265686</fAllData>
 <fAllData>1.014266</fAllData>
 <fAllData>101426.570313</fAllData>
 <fAllData>101.426567</fAllData>
 <fAllData>760.761841</fAllData>
 <fAllData>29.239281</fAllData>
 <fAllData>1.034267</fAllData>
 <fAllData>1014265.687500</fAllData>
 <fAllData>0.401409</fAllData>
 <fAllData>0.000000</fAllData>
 <fAllData>0.000000</fAllData>
 <iBarGraphMin>0</iBarGraphMin>
 <iBarGraphMax>10</iBarGraphMax>
 <iBarGraphValue>6</iBarGraphValue>
 <bHeatState>false</bHeatState>
 <bCoolState>false</bCoolState>
 <bPacerState>false</bPacerState>
 <sStatus>Control Alarm1</sStatus>
 <retval>GEIAPI_SUCCESS</retval>
</OpticaAPIReturn>
```


bHeatState, bCoolState and bPacerState indicate whether the unit is in MaxHeat, MaxCool, or Pacer, respectively.

G.2.8 4X40 Optica Configuration

Using an RS-232 communication link, the user can set the network settings. To see the set of supported commands, type "$Help<>"

1. **$SetIPAddress <IP ADDRESS><>**
   (i.e. $SetIPAddress 3 112 60 36)
2. **$SetIPSource <STATIC><>** (Assuming STATIC IP)
3. **$SaveNetworkSettings<>**
4. **$GetNetworkSettings<>** (Displays the current network settings)

It takes time to execute the "SaveNetworkSettings" command. Wait until the display updates to determine when to reset the unit. In order for the settings to take effect, power to the unit must be cycled.

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Warranty

Each instrument manufactured by GE Sensing is warranted to be free from defects in material and workmanship. Liability under this warranty is limited to restoring the instrument to normal operation or replacing the instrument, at the sole discretion of GE Sensing. Fuses and batteries are specifically excluded from any liability. This warranty is effective from the date of delivery to the original purchaser. If GE Sensing determines that the equipment was defective, the warranty period is:

- one year from delivery for electronic or mechanical failures
- one year from delivery for sensor shelf life

If GE Sensing determines that the equipment was damaged by misuse, improper installation, the use of unauthorized replacement parts, or operating conditions outside the guidelines specified by GE Sensing, the repairs are not covered under this warranty.

The warranties set forth herein are exclusive and are in lieu of all other warranties whether statutory, express or implied (including warranties or merchantability and fitness for a particular purpose, and warranties arising from course of dealing or usage or trade).

Return Policy

If a GE Sensing instrument malfunctions within the warranty period, the following procedure must be completed:

1. Notify GE Sensing, giving full details of the problem, and provide the model number and serial number of the instrument. If the nature of the problem indicates the need for factory service, GE Sensing will issue a RETURN AUTHORIZATION NUMBER (RAN), and shipping instructions for the return of the instrument to a service center will be provided.
2. If GE Sensing instructs you to send your instrument to a service center, it must be shipped prepaid to the authorized repair station indicated in the shipping instructions.
3. Upon receipt, GE Sensing will evaluate the instrument to determine the cause of the malfunction.

Then, one of the following courses of action will then be taken:

- If the damage is covered under the terms of the warranty, the instrument will be repaired at no cost to the owner and returned.
- If GE Sensing determines that the damage is not covered under the terms of the warranty, or if the warranty has expired, an estimate for the cost of the repairs at standard rates will be provided. Upon receipt of the owner's approval to proceed, the instrument will be repaired and returned.

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